THE RHODESIA

# Agricultural Journal.

*Edited by the Director of Agriculture*
*(Assisted by the Staff of the Agricultural Department).*

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## EDITORIAL.

*Contributions and correspondence regarding subjects affecting the farming industry of Southern Rhodesia are invited. All communications regarding these matters and advertisements should be addressed to:—The Editor, Department of Agriculture, Salisbury.*

**Charges for Analysis.**—Attention is called to the scale of charges for analysis by the Chemical Branch of this Department, which is reprinted in this issue from the *Government Gazette*.

It will be noted that all samples for analysis are to be delivered free of cost to the Department and must be accompanied by a remittance to cover the cost of analysis, and that no modification of the fees stated will be made except with the authority of the Minister.

No charge will be made for a partial analysis of soil samples from *bona fide* farmers when undertaken to determine the suitability for crops and/or to make suitable recommendations regarding fertiliser requirements.

In every other case a charge will be made.

The Department often has requests for complete or partial analysis of a well known fertiliser. These are appar-

ently made with the idea of checking up the composition with the advertised standard. There is absolutely no need for farmers to make such a request, since the analysis is constantly checked under the requirements of the Fertilisers and Farm Foods Ordinance.

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**Contour Ridges.**—The particularly fine rains which have been experienced in most districts during this present season have awakened renewed interest in contour ridges.

A considerable number of enquiries have been received, and it has been considered desirable by the Irrigation Branch of this Department to review the position.

In this issue Mr. R. H. Roberts, the Assistant Irrigation Engineer, replies to some of the questions raised, and his explanations should allay some of the fears that have been expressed by farmers in respect of contour ridges which they had previously constructed on their farms.

The question of soil erosion is such an important one that we have no doubt that the review appearing in this issue will be welcomed.

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**The World Wheat Position.**—A comprehensive and interesting review of the world wheat position was published in February last as the 20th Report of the Imperial Economic Committee.

It deals with a large variety of the more important aspects of the subject, reviewing the trend in prices, production, acreage, yield, etc. The technical advances, the variations in consumption and the various actions which have been considered necessary by the various States is also reviewed, and a number of graphs and statements at the end enable a large amount of material to be condensed into a report of about 120 pages.

The present outlook may be summarised by the following extracts:—

"The outstanding feature of the wheat situation is the catastrophic fall in price since the autumn of 1929 following upon a relatively slow downward trend in prices since 1925.

We have set out the main factors which have contributed to this result. Our general conclusion is that the fall in prices cannot be explained solely by reference to the supply position, but is a result partly of the development of supplies, partly of the spread of the economic depression. The term 'over-production,' which in recent years has been so frequently applied to the wheat situation, is obviously a relative one. Our own view is that if applied to the post-war period as a whole it is misleading. Over-production has not been the outstanding feature of these years if we have regard to pre-war trend—rather the reverse; nor in our judgment does over-production describe the salient features of the last two years. The truth of the matter lies much deeper. The many economic impediments—largely the outcome of the war—which have obstructed the full development of the world's economic life during the last thirteen years and the setback in economic progress brought about by the depression of 1930 and 1931 are factors at least as important as the expansion of production in accounting for the low level of wheat prices. Nevertheless the position which has been reached is equivalent to one of over-production in relation to effective demand, and has led to a situation in which wheat production has ceased to be profitable over vast areas of wheat-growing land. . . ."

"On such figures as these it is impossible to forecast even approximately the course of wheat prices over the coming twelve months. So much depends upon the developments of the world's general economic situation that a forecast related merely to the statistical position of wheat cannot to-day be of much value. It would be a mistake to look for a rise in wheat prices solely to the restriction of production. Hope lies, at least as much, in a recovery from the world-wide economic depression, which affects manufacture and commerce as well as agriculture. The problem of wheat is fundamentally a part of the general problem. The removal of the obstacles which to-day impede the recovery of industrial life would go a long way towards bringing about an improvement in the wheat situation."

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**Arsenic on Citrus Trees.**—During the last twenty years the use of arsenic in some form or other as an insecticide has

been very greatly developed. For use in dips a soluble form of arsenic was desirable and arsenite of soda is now in general use. A soluble form, however, cannot be used on plants, as it is fatal to plant life.

As an insecticide for the protection of plants, therefore, the insoluble arsenate of lead came into general use, and in this form was recommended for the protection of all plant life against biting insects.

A few years ago it was suspected that the use of even arsenate of lead on citrus had a harmful effect on trees, which was indicated by the loss of acidity and general flavour of the fruit. This has now been definitely shown to be the case, and although no trace of arsenic can be discovered in the juice of the fruits even when excessive amounts have been used, there is no doubt that an important chemical change is developed in citrus trees sprayed with arsenic.

The percentage of citric acid is lowered, the quality of the sugars is lessened, and the amount of Vitamin C is seriously reduced. How the arsenic acts upon the tree has not been established, but this discovery suggests new possibilities of determining some of the chemical changes taking place in plant life which have hitherto been difficult to ascertain. The effects on the fruit are sufficiently great to render it unsuitable for export and the use of arsenic in any form on citrus trees should be discontinued.

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**The Shirley Cotton Institute.**—The Shirley Cotton Institute is one of the finest laboratories in England. In spite of lean times in the cotton industry, manufacturers see in scientific research one of the hopes of the future, and subscriptions have kept up well. There is a staff of nearly 200, of which about 70 are fully qualified scientists. The income of the Association is over £53,000 a year, four-fifths of which is subscribed by the cotton trade and the remainder by the Government's Department of Scientific and Industrial Research. Even more impressive is the fact that about 80 per cent. of the cotton manufacturers in the country are members of the Association.

There has been no fundamental discovery of outstanding importance in the cotton industry for many years, but there have been a very large number of small improvements and advances in knowledge which, when added together, reach a substantial total. In fact, it has been suggested that a saving of something like £300,000 a year is being effected in Lancashire by research—a return of 500 per cent. on the money invested.

*Empire team-work is well practised in cotton research.* The cotton industry stretches right from the sun-baked fields of Uganda or Queensland to the damp, clattering mills in Lancashire, and beyond to export markets. Science has to watch every link in this continuous chain. The Shirley Institute is the only body in the cotton industry with a vertical view—that is to say, it is the only body competent to trace a fault back from one stage of processing to, perhaps, the climate or soil in the country where the cotton was grown, or to some mistake in the ginning, or to damage during transport.

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**Economic Problems.**—The farmers of to-day are faced with an anomalous—it seems almost an impossible—problem, that *of reducing the cost of* production without increasing the volume of production of some of the staple farm products. The cost of production of manufactured articles has been brought to a high state of efficiency under the stimulus of a constantly increasing demand for their products. The farmer has no such incentive. He knows that there is an over-production of many of his products, and he sees no relief in the near future, for he has to compete in the world markets, and vast areas of agricultural land are being brought into use, and everything that lessens the cost of production or transportation anywhere in the world, except in his own immediate locality, makes his struggle more difficult. His only hope seems to be that possibly he may, by more efficient methods, implements and managerial ability, drive some other farmer out of business and convert him and his family from competitors in agricultural production into consumers of agricultural products. This is being done on an enormous scale throughout the United States at the present time.—(U.S.A. Dept. Ag. Misc. Circular, October, 1931.)

**Increased Yields of Potatoes due to Fertilisers.**—Bulletin No. 410 of the Wisconsin Agricultural Experiment Station, appropriately entitled "New Science for an Old Art," contains an interesting note about the effect of concentration of fertilisers. Ten loads of farmyard manure per acre applied to potatoes produced a yield of 173 bushels per acre. An addition of 800 lbs. per acre of a 5-8-7 fertiliser resulted in a yield of 253 bushels per acre, an increase of 80 bushels due to the artificials, and costing less than 25 cents per bushel. 400 lbs. (half a dressing) of a 10-16-14 fertiliser (double concentration) gave 251 bushels, an almost identical increase obtained at less cost for the fertiliser and with less labour for handling and distribution. A fertiliser with more potash still further increased the yields without appreciable increase of cost; 800 lbs. of a 3-12-12 fertiliser, given in addition to farmyard manure, produced exactly the same average yield. The report advises that highly concentrated fertilisers should be well mixed with the soil, and should not come in close contact with the seed. The soils in the experiment were loams, and fertilisers were carefully distributed, and there was adequate moisture during the early season.

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**Bleaching of Pea Nuts.**—An interesting and instructive article on the bleaching of pea nuts appeared in the February issue of "Farming in South Africa," and in order to try it out with Rhodesian varieties, experiments were conducted by the Chemistry Branch at the agricultural laboratory in Salisbury, with very satisfactory results.

Four separate samples of nuts from different types of soils, and with varying conditions of colour and cleanliness, were kindly submitted by the Farmers' Co-op., Ltd. These were as follows:—

No. 1.—Yellow.
No. 2.—Dirty red.
No. 3.—Blackened by rain.
No. 4.—Dirty light red.

The active agent employed was a 2 per cent. solution of sodium bisulphite, the compound which has been proved in the Union trials to give most satisfactory results with least

The first step in the process was to wash the samples of nuts for five minutes with a soft nail brush in clean water. They were then transferred to a basin containing ten times their weight of the 2 per cent. solution of the bisulphite, and brushed here again for five minutes. The treatment ended by washing in running water for three or four minutes and spreading out to dry in the sun on a large inverted sieve.

Two variations of this method were also tried out. In one no brushing whatsoever was done, the nuts, apart from that, receiving the same treatment as far as concentration of chemical, time of soaking, washing and drying were concerned. In the other, brushing was resorted to in the water, but only stirring with a wooden rod in the bisulphite was given.

The results where brushing at one or both stages was a part of the process were excellent and produced nuts perfectly clean and with their original and normal sheen unblemished. There was little, if anything, to choose between the final products of those which had been brushed only once and of those which received two brushings, but the non-brushed samples were so little improved that it is evident that brushing, whether once or twice, is an essential part of the treatment. Washing alone without brushing does not remove the minute particles of soil adhering to the innumerable little pits in the shell, and the latter continues to look dirty in appearance.

No injurious effects are left upon the nuts; the time (five minutes) is too short for the weak solution of bisulphite to penetrate the shell, and chemical tests verified that the last trace of it had been removed by the final washing in running water.

This method was quite ineffective with the third sample consisting of nuts blackened by rains, and it is highly improbable that these could ever be cleaned owing to the changes that have taken place in the shell tissues due to the moisture absorbed. It was also ineffective with shell-broken nuts, but these in any event would be unfit for export purposes.

It should not be too difficult or too costly to apply this method on a large scale. Although not tested out in the course of these experiments, the same solution of sodium

bisulphite, according to the writers of the article above mentioned, can be used 15 times or oftener for the treatment of the nuts. Now 1 lb. of nuts requires 10 lbs. of a 2 per cent. solution of the bisulphite, i.e., 100 lbs. nuts require 20 lbs. of the solid. The wholesale price in England is approximately 9d. per lb., which would mean 15s. per 100 lbs. of nuts, but as the solution can be used 15 times, the cost of the chemical is roughly 1s. per 100 lbs. nuts.

Although the whole process could be carried through by means of broom brushing by native labour in large wooden or cement tanks, it is considered that, although much more costly, of course, some form of mechanical rotary brush arrangement would be preferable, giving greater efficiency and convenience. Perhaps it would be advisable to try out the method on a large scale in the first place with brooms, and consider the rotary brushes if the former were successful, which, given proper supervision, it ought to be.

## HANDBOOK OF TOBACCO DISEASES.

Attention of readers is drawn to the fact that the Department of Agriculture has found it most inconvenient, with the present shortage of staff, to handle the local sales of this book. Arrangements have therefore been made with the Rhodesian Printing and Publishing Company for distribution by them throughout Southern Rhodesia. The book may be obtained from the Herald Store, Salisbury, price 4s., or, postage paid, 4s. 4d.

# PESTS OF STORED TOBACCO IN SOUTHERN RHODESIA.

By M. C. Mossop, M.Sc., Entomologist.

## INTRODUCTORY.

The problems associated with the presence of insect pests in stored tobacco have been investigated in Southern Rhodesia during the last few years. Owing to the accumulation during 1928-29 of surplus stocks of Empire tobacco in London, including some 17,000,000 lbs. of Rhodesian tobacco, a heavy fall in prices occurred, which was accentuated by the discovery in 1929 in the warehouses there, and in baled tobacco, of the stored tobacco worm, *Ephestia elutella,* Hubn. (Figs. 1 and 2). This insect is overseas primarily a pest of other stored products, especially cacao beans and peanut (*Arachis*) products. The first record of its presence as a serious pest of stored tobacco was reported in 1928 from Bulgaria. It was later found in leaf and other tobacco, including the Rhodesian product stored in the London bonded warehouses. In August, 1930, it was found infesting tobacco in the United States.

The original source of the pest in Rhodesian tobacco stored in London could not be traced definitely, but over two years ago it was found in tobacco from this Colony on its arrival in London. At the same time careful search failed to reveal the pest in Southern Rhodesia or Beira, and it was not until April, 1930, that a few specimens were found in imported chocolate, and finally, in June, 1930, on stored tobacco in Salisbury. As long ago as 1915 this insect was recorded as a pest of peanuts in Nyasaland.

The cigarette beetle, *Lasioderma serricorne,* F. (Figs. 3 and 4), or the tobacco "weevil," as it is sometimes called, has been present in this Colony for a number of years, and is a cosmopolitan pest. This insect also feeds on stored products other than tobacco.

In order to ensure that tobacco exported overseas from Southern Rhodesia would be as free from pests as reasonable preventive legislation could contrive, and thus to regain the confidence of overseas buyers and thereby raise the market value of our tobacco, the Tobacco Pest Suppression Act was passed in 1931. This Act provides for the licensing of all premises where unmanufactured tobacco is prepared or held for export, for the inspection and cleansing of all such warehouses and for the destruction of infested tobacco where necessary. The provisions of this Act and the regulations published thereunder are of importance to all tobacco growers.

Public interest in pests of stored tobacco has now been aroused, and the following information on the biology and suggestions regarding avoidance and control of the two principal pests are given below.

## EPHESTIA ELUTELLA.

*Ephestia elutella*, Hubn., is known overseas as the cacao moth, cacao bean moth and chocolate moth. In Southern Rhodesia the insect is known only as a pest of stored tobacco at present, and as it is desirable that its common name should be associated with that commodity, the name "stored tobacco worm" is suggested. The group of insects to which it belongs includes many well-known pests of stored products.

### THE MOTH.

If a warehouse is infested, close examination during late spring and summer of the walls and ceilings and any baled tobacco that may be present will usually result in the discovery of the adult moths, but during the late winter and early spring the closest examination may fail to disclose any. The moth has a predilection for dark corners, and when disturbed will often fly about for half a minute or more without moving far from its original position. When the moth alights the wings are folded close to the body, and the body is usually held at an angle to the surface upon which it rests with the head pointing away from this surface. The habit is, however, by no means peculiar to *E. elutella*.

The moth (Fig. 1) with wings folded measures about $\frac{3}{8}$ in. from the head to the tip of the wings, and with wings

FIG 1

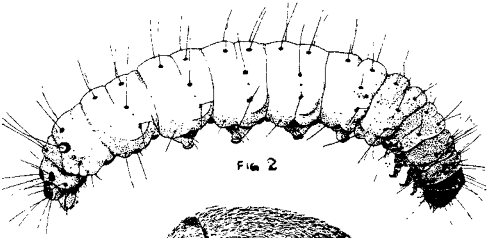

FIG 2

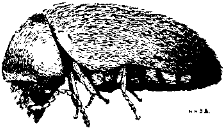

FIG 3

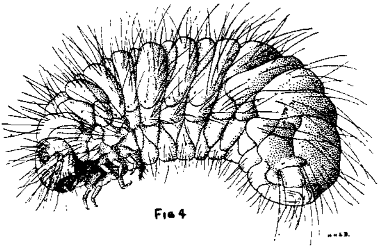

FIG 4

Fig. 1. *E. elutella*, adult, enlarged. After Bovingdon.
Fig. 2. *E. elutella*, larva, enlarged. After Bovingdon.
Fig. 3. *L. serricorne*, adult, enlarged. After Bovingdon.
Fig. 4. *L. serricorne*, larva, enlarged. After Bovingdon.

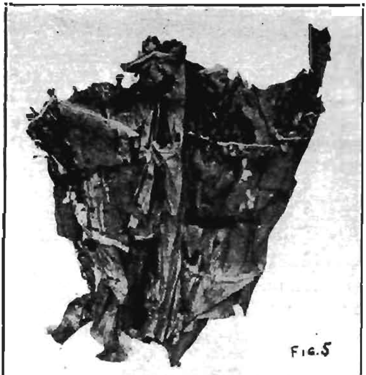

Fig 5. Tobacco showing feeding damage and frass of E. *elutella*, natural size.

Fig. 6. Tobacco showing tunnelling of *L. serricorne*, natural size.

spread out, $\frac{5}{8}$ in. to $\frac{3}{4}$ in. from tip to tip. The colour of the forewings and body of a fresh specimen is a fairly dark brownish grey, the brown being slightly more pronounced in lighter coloured specimens. There are two light bands across each forewing, the inner one being straight and transverse and the outer one sinuous like an almost straightened, reversed "S" and only slightly transverse. Older specimens, or those kept in captivity, lose many of the wing scales and appear a much lighter grey, often showing a dark border to the original white lines, which have become invisible. The hind wings are of a uniformly light brownish grey with a thin dark line on the margins (except the front), edged with a thin white line. The antennæ are thread-like and delicate, and when at rest lie backwards over the body.

Food is apparently not essential to the moth, although it will suck up water and probably other liquids. The purpose of the adult appears to be to reproduce and disseminate its kind. The moth may mate and the female lay eggs soon after emergence from the pupal stage, but, in captivity at any rate, the bulk of the eggs laid by a mated female appear from the second to the fourth day. Egg laying may continue for at least eight days, and a total of 97 eggs have been obtained from one mated female in Salisbury. Observers overseas have recorded more than twice this number. The percentage of fertile eggs has not been ascertained. Unmated females have laid up to 60 eggs each, all of which have failed to hatch. The moth, both male and female, lives for about twelve days or less.

## THE EGG.

The egg is oval in shape with a somewhat warty and wrinkled surface, and dull cream in colour. The colour darkens slightly with age. The length varies from 1-55 to 1-40 in., and the width is from half to two-thirds the length. Eggs are laid singly on the tobacco or on the hessian covering of the bale, although a group of several individual eggs may sometimes be found scattered in a small area. Hatching occurs in five to ten days according to the temperature.

## THE LARVA.

The newly hatched larva or caterpillar is small, yellowish white, and with a thin body and comparatively large head.

The distance it can crawl is not known, but when confined in a tube without food it crawls about for many hours. The young larva exhibits cannibalistic tendencies, preferring the dead bodies of the adults or of other insects to tobacco as food. This diet, however, is not a necessity, for the dead adults have usually been removed from the rearing jars before the eggs have had time to hatch.

The caterpillar (Fig 2) possesses three pairs of thin, articulated legs on the first three segments near the head, and four pairs of thick, fleshy false legs on about the middle third of the body and one pair on the last segment. The body of the growing caterpillar is pinkish in colour, changing when full grown to a yellowish white. The head is brown, and immediately behind is a pair of brown plates. A lighter brown plate occurs on the last segment of the body. The caterpillar is clothed with sparse hairs, the individual hairs arising from small, dark brown spots which give the caterpillar a characteristic appearance. The full-grown caterpillar is about $\frac{3}{8}$ to $\frac{1}{2}$ in. long.

**Feeding Period.**—When reared in Salisbury on Rhodesian flue-cured bright leaf tobacco, the larva feeds usually for about two to three months. It then commences to wander about in search of a suitable crevice, preferably away from the tobacco, in which to spin up and rest or pupate. A strong tendency to climb is exhibited by the wandering larva.

In rearing the insects the writer has taken advantage of these habits and has been able to obtain the larvæ as soon as they have left the tobacco by placing strips of corrugated cardboard inside the tops of the rearing jars. When a larva has ceased to feed it wanders about inside the top of the jar and eventually enters a crevice in the cardboard. The difference between the date of hatching and the date on which the fully fed larvæ have been found (commencement of the larval resting period) has been taken as the duration of the feeding period. Based on observations of behaviour, suitable precautions have been taken to ensure that no larva recorded as having fed for a long period has been hiding fully fed in the tobacco during a portion of the time recorded.

By this method, feeding periods of 40 to 198 days have been recorded, with about 60-90 days as the normal under

favourable conditions. The larva is not necessarily feeding during the whole of this time, as it may possibly become inactive at low temperatures and continue to feed when its surroundings become warmer.

**Larval Resting Period.**—The wandering larva soon settles down and may or may not spin a flimsy, white cocoon. When it has thus settled, it usually remains motionless and may pupate within a few days, or may remain *in situ* as a larva for a few weeks or months.

The length of the larval resting period varies even more than that of the feeding period. The resting period is here reckoned as the time between cessation of feeding and commencement of pupation, and varies from three days to ten months. The latter record is not absolutely reliable, as the insect concerned died just when its behaviour indicated imminent pupation. However, some reliable long larval resting periods recorded are seven and over nine months. The normal period under favourable conditions is from a week to a month.

Temperature appears to be a main factor controlling this period. This may be seen in records of individuals that ceased to feed in autumn and winter. Out of 27 larvæ hatched in early January, 1931, the individuals of which ceased to feed between March and July, 4 had a larval resting period of under 51 days, 9 rested from 51 to 100 days, 11 from 101 to 150 days and 3 from 151 to 195 days. Similarly, of 22 larvæ in a generation hatched in early March, 1931, the individuals of which ceased to feed in May and June, none had a larval resting period of under 51 days, 14 rested from 51 to 100 days and 8 from 101 to 131 days. Nearly all the individuals of these two more or less parallel generations pupated during the latter half of August or the first half of September when warm weather set in. Mass pupation thus occurred at a period of low humidity and high evaporation, but the vital factor influencing pupation during these months appears to be almost entirely connected with a rise in temperature. Breeding experiments with controlled humidities have not been carried out.

The above observations are substantiated by the fact that in a local cigarette factory mass pupation took place during

August and September, after which only a negligible number of fully fed larvæ were seen until December, when larvæ of a new generation were taken. Further evidence of the effect of temperature was obtained when of 35 larvæ taken from the same environment on 1st July, 18 were kept at ordinary room temperature and 17 in a heated room; 70 per cent. of those in the heated room pupated and emerged during July and August, while none at room temperature emerged before September.

There is evidence, however, of the existence of an unidentified factor also influencing the length of the larval resting period.

The above figures indicate that the total larval period may vary considerably and extend over long periods. Records of total larval life vary between the extremes of 44 days and 365 days in Salisbury.

**Damage done to Tobacco by the Larvæ.**—The larva attacks almost any kind of bright flue-cured tobacco, but has not been recorded as a pest of fire-cured leaf. It feeds on any part of the leaf except the veins, making irregular-shaped cavities in baled tobacco (Fig. 5). These cavities are often partly filled with dark brown particles of fæces held together in bunches of various sizes by threads of silk spun by the caterpillar. The bunches of excreta are dark brown to black in colour, their presence giving an unsightly appearance to the tobacco. The excrement is, as a rule, more quickly noticed than the actual damage to the leaf. That of the young caterpillar is light brown, but of the older ones dark brown to black, but light brown at one end, blunt at both ends and usually slightly waisted in the middle.

**Food of the Larva.**—The stored tobacco worm has been described overseas as being catholic in its tastes, having been known to attack a very wide range of stored products, including cacao beans, cacao powder, chocolate, cured tobacco in various forms, many kinds of seeds, dried fruits, peanuts and peanut products, shelled walnuts, pearl barley, linseed and flax-seed meal, sugar beet, garlic roots, stored flour, army and dog biscuits, bread, cakes, sugar, dried vegetables, rice, coffee, red and cayenne pepper and dead insects.

**Parasites of the Larva.**—The prolongation of the larval stage is one of the weak phases in the life history of the stored tobacco worm, as it affords increased opportunities for the attacks and multiplication of a small parasitic enemy, *Microbracon hebetor*, Say. This insect, after stinging its prey to produce a condition of paralysis, lays eggs on the skin of the now inactive and defenceless caterpillar. After hatching, the young parasitic wasp grubs remain on the outside of the caterpillar feeding on its tissues for about a week before they become full-grown. They then spin neat, white, oval, silken cocoons on the caterpillar, or perhaps, more often, a few inches away from it, and pupate. The adult emerges in a few days, and as many as thirteen adult parasites have been reared in Salisbury from one larva of the stored tobacco worm. It frequently happens that a female parasite will sting a caterpillar without laying eggs on it. Such caterpillars eventually die, although they may live for several days, as indicated by the beating of the heart. A stung caterpillar, whether eggs have been deposited on it or not, may be recognised by its inactivity and flaccid unhealthy appearance. As paralysis in the caterpillar is produced soon after the insect is stung, paralysed larvæ may often be seen fully exposed on walls, etc., over which they have been wandering when attacked.

## THE PUPA.

Pupation of the stored tobacco worm usually takes place in a flimsy, silken, whitish cocoon. Sometimes, however, there is no cocoon; at others the silk is so thickly spun that a tough cocoon is formed. When the caterpillar spins up in a crevice such as a nail hole the cavity is lined with silk and a silken barricade spun over the entrance. Frequently a hole is left in this barricade and may be used by the moth as an exit, or by parasitic enemies reaching or leaving a victim. Before pupating, the larva assumes a sickly white colour, giving the impression that the insect is diseased. A final ecdysis or shedding of the larval skin occurs, and a pale cream-coloured pupa is formed. The colour gradually darkens through amber to almost black, the wings showing up darker than the body. The dark colour observed is really that of the fully developed moth as seen through the thin, semi-trans-

parent amber pupal case. On completion of metamorphosis the moth becomes active inside the pupal case, and the latter splits at the head and down the ventral surface. The adult moth emerges, casting off the pupal case, and forces its way out of the cocoon. Immediately after emergence, the moth rests for a short time while its wings are expanding and drying. After about twenty minutes this process is complete and the moth is able to fly away.

The period of pupation has varied in Salisbury from 9 days in early summer to 50 days in mid-winter. The usual period is about 10 to 20 days in summer and 18 to 28 days during the time of mass pupation in spring.

## EXPERIMENTS WITH *E. ELUTELLA*.

A number of preliminary experiments in control have been carried out with a view to obtaining data on which further tests may be based. Owing to the unpromising nature of the results obtained and in some cases to lack of opportunity these tests have not been repeated. The experiments were made possible through the kindness of the staff of a local cigarette factory who provided the necessary facilities. The details and results of the tests carried out to date are given below, the objects of the individual tests being evident from the statement of results. Tests (2) to (13) were simultaneous.

(1) Exposure of three batches of eggs to a temperature of 133 deg. F. for five minutes in a tobacco drying cylinder in normal operation. The temperature recorded was that of the cut tobacco on removal from the cylinder. No exposed eggs hatched; 21 out of 23 control eggs hatched.

(2) Three balloon fly traps set with a bait of unsweetened chocolate for 12 days. Total catch, one adult female.

(3) Two sheets of home-made fly paper each ten inches square, with chocolate incorporated in the sticky material (adhesivity fair), placed on top of stacked bales for 12 days. Total catch, eight moths, five larvæ.

(4) Two sheets of plain, home-made fly paper (adhesivity good), each ten inches square, placed on top of stacked bales for 12 days. Total catch, 64 larvæ.

(5) Two papers, each ten inches square, smeared with melted chocolate and left on bales for 12 days. No eggs deposited.

(6) Two papers, each ten inches square, smeared with a mixture of chocolate and water, dried, and left on bales for 12 days. No eggs deposited.

(7) One pan, ten inches square, smeared as in (5) and left on bales for 12 days. No eggs deposited.

(8) One pan, ten inches square, smeared as in (6) and left on bales for 12 days. No eggs deposited.

(9) One pan, ten inches square, containing chocolate powder, left on bales for 12 days. No eggs deposited.

(10) One pan, ten inches square, containing chocolate and water left on bales for 12 days. Catch, 6 male and 5 female moths.

(11) One pan, ten inches square, containing water left on bales for 12 days. Catch, 19 moths, sex not identified.

The positions of (10) and (11) were interchanged several times.

(12) One pan, 6 ft. by 1 ft., containing water left on top of stack for 6 days. Catch, 53 male and 5 female moths.

(13) One pan, 6 ft. by 1 ft., containing water left in a space in middle of stack for 6 days—simultaneously with (12). Catch, 22 male and 20 female moths.

(14) Three strips of corrugated cardboard, each 1 ft. long and ¾ in. wide, tacked horizontally on a wall with three feet of floor space between the wall and some stacked bales, and left for two days. Catch, 5 larvæ.

(15) Forty feet of corrugated cardboard strips (33 feet horizontal and 7 feet vertical over an obstacle) tacked along a wall parallel to a row of stacked bales and three feet therefrom, and left for 12 days. Catch, 13 pupæ, 158 larvæ. The larvæ were heavily parasitised by *M. hebetor.* This catch is equivalent to a catch of 1.3 larvæ per horizontal yard per day.

Further catches were made on the same site, and the results are given below in terms of the average number caught during a portion of each month per horizontal yard of corrugated cardboard per day:—

| | |
|---|---|
| April, 1931 (as above) ... ... ... ... | 1.3 |
| *July* ... ... ... ... ... ... ... ... ... ... ... | 0.43 |
| *August* ... ... ... ... ... ... ... ... ... ... | 0.34 |
| September ... ... ... ... ... ... ... ... ... | 0.02 |
| October-November ... ... ... ... ... ... | 0.01 |
| November ... ... ... ... ... ... ... ... ... | 0.03 |
| December ... ... ... ... ... ... ... ... ... | 0.21 |
| January, 1932 ... ... ... ... ... ... ... ... | 0.27 |
| February ... ... ... ... ... ... ... ... ... ... | 0.52 |

The sudden drop in the number caught in September is accounted for by the occurrence of mass pupation of larvæ on the arrival of warm weather in late August and September. The sudden rise in December is considered to be due to migration from the bales of fully-fed larvæ of the new generation bred from the moths that emerged in spring. Rearing experiments in the laboratory confirmed the foregoing conclusions.

## LASIODERMA SERRICORNE.

*Lasioderma serricorne*, F., is known under a number of popular names, such as cigar beetle, cigarette beetle, tobacco beetle, and sometimes tobacco weevil. It is not a true weevil (Curculionidæ), but belongs to a family of beetles (Anobiidæ) which live chiefly on dried vegetable matter, including timber.

The tobacco beetle is known primarily as a pest of some form of cured tobacco, but it is also a serious past of ginger, copra, and copra cake. It has been recorded from over seventy stored products, including rice, raisins, rhubarb, cayenne pepper, dried fruit, coffee, ergot, dried beans, cumin seed, stored pulses, turmeric, liquorice, dates, chick peas, spices, belladonna, saffron, cane work, vegetable material in upholstery, cotton bolls, dried drugs, seeds, books, leather, insect powder, and strychnine!

### THE BEETLE.

The adult beetle (Fig. 3) is of a brown to reddish brown colour, and is $\frac{1}{8}$ to $\frac{1}{10}$ in. long. The size varies considerably. The head and prothorax are usually seen bent downwards in a characteristic attitude as in Fig. 3.

It is not known to attack growing tobacco in the field, although it has been reported in Nyasaland as breeding in the field in old, shrivelled cotton bolls previously attacked by cotton stainers and other insects. The beetle is slightly attracted to light and may be caught in fair numbers, in relation to the infestation, on windows in warehouses. It is a moderately strong flier and is especially active in the late afternoon.

The adult can bore its way out of containers of paper, cardboard, and other materials, but it is doubtful whether it eats its way *into* such containers. The evidence produced by the examination of a number of perforated cigarette boxes strongly suggests that the holes were made from the inside. A series of tests has been carried out to demonstrate whether the beetle can bore its way through to tobacco securely sealed in bags of ordinary brown paper or bags of tarred paper as used for wrapping bales. In no case was a bag perforated by the beetle.

Reverse tests, in which infested tobacco was packed in sealed bags and kept under bell jars, showed that the beetles could bore their way out, though they were able to find, and preferred to use, holes already made by erstwhile fellow prisoners. This is in keeping with the findings of Zacher, whose work with the grain weevil *Sitophilus (Calandra) granaria*, L., is referred to by Richards as follows:—"He found that beetles shut up in various types of cartons, whether given food or not, always eat their way out. On the other hand, beetles enclosed in a glass vessel with food only available inside a carton never eat their way into it but die of starvation."

Copulation may take place soon after the beetles emerge from the pupal cells, the fertilised female laying from 25 to 30 eggs over a period of about three weeks. The eggs are usually deposited in the folds of the leaves, in the exposed butts of the hands in the bales, or in the ends of cigarettes or cigars. In Salisbury the beetles of the first brood, which normally emerges in September and October, commence to lay eggs immediately. Subsequently the broods overlap to a large extent. The beetle may live for five to six weeks normally, but much longer in winter.

## THE EGG.

The egg is white, about 1-50 in. long, with a smooth, toughish shell, and is deposited in situations as described above. Hatching occurs in from six to ten days.

## THE LARVA.

The newly hatched larva is a small, whitish, hairy grub. It can crawl short distances, but as a rule soon settles down to feed. The grub ceases to migrate after it has commenced to feed, its movements probably being confined to a few cubic inches of tobacco. Feeding activities result in the characteristic tunnels seen in Fig. 6, in which the tunnels are shown both in cross and longitudinal section.

The grub (Fig. 4) is usually found in a curled attitude, the abdomen being bent round almost double. This attitude is struck when the insect is disturbed. The full grown grub measures about ⅛ in. long. The head is brown and the body yellowish white, with three pairs of jointed legs behind the head. The body is covered with numerous moderately long hairs as shown in Fig. 3, which collect and carry a certain amount of frass and tobacco dust. The excrement is dark brown to black, roughly barley shaped, being more or less pointed at both ends. The grub normally feeds for two to three months in Salisbury, shedding its skin several times, and then constructs from the surrounding debris a smooth-lined cell in which to rest. This cell is constructed at or near the site of feeding.

Then follows a period of rest which may vary from a week in favourable weather to several months during autumn and winter. About 50 larvæ under observation in Salisbury commenced their rest in mid-April, and did not pupate until mid-September—five months. The larval stage is the common hibernating stage of the insect.

## THE PUPA.

Pupation does not occur immediately after the cell has been constructed, the grub remaining quiescent for about one week under optimum conditions of temperature;

but under unfavourable conditions this resting period may be prolonged several months. As soon as conditions are favourable the grub gradually takes on the pupal form, at the same time contracting to about ⅛ in. long. The new pupa is glossy white, but gradually turns a reddish brown after a few days. The legs, wings, eyes, and other external features of the adult can be recognised in the pupa. The period of pupation varies from six to ten days, after which the adult may remain in the cell for two days or so before emerging.

## ENEMIES.

Enemies of *L. serricorne* in Southern Rhodesia consist of at least one small hymenopterous parasite, and a species of mite. The hymenopterous parasite has not been identified, nor has its life history been studied. The mite is the cosmopolitan, predacious *Pediculoides ventricosus*, Newp., which has been observed to kill many larvæ and papæ. It has been seen mostly in the cells in which the larvæ rest and pupate. The males and uninflated females are very small, but visible to the naked eye. The gravid female, however, becomes inflated with young, and has the appearance of a yellowish pearl about the size of a pin's head.

## PRECAUTIONARY MEASURES.

The Department of Agriculture has for some time been urging tobacco growers and managers of tobacco warehouses to observe scrupulous cleanliness, during the spring and summer months especially, in regard to rooms, barns, stores, etc., where tobacco is stored or handled. The wisdom of having no tobacco whatsoever in or near the premises is recognised, but cleaning up is usually not practised with sufficient thoroughness to render it as effective as it should be. Both the cigarette beetle and the stored tobacco worm require but a small amount of cured tobacco to bring them to maturity. Cracks in floors, spaces under wooden floors or between bricks near the floor, many cracks and crevices in the press itself and around its foundations, each and all are liable to harbour scraps of tobacco sufficient to support a population of pests over the spring and summer months.

Although the duration of the life cycle of both these tobacco pests is normally somewhat extended during the autumn and winter months, the artificial temperature and humidity maintained in the grading sheds at this time afford favourable conditions for continued emergence and breeding of these insects. Thus the new crop may become infested soon after it is brought in from the barns.

As a result of the first season's inspection of tobacco warehouses under the *"Tobacco Pest Suppression Act, 1931,"* it was found, as was expected, that warehouses that had received thorough cleaning after early disposal of all tobacco —saleable and waste—were free of pests. However, the inspectors were nearly always able to find a few scraps of tobacco on the premises, and it would appear that the comparative isolation of farm warehouses in which tobacco pests have not yet been discovered is an important factor in their freedom from pests. The benefit of isolation will be lost, at least temporarily, once the warehouse becomes infested.

The Tobacco Pest Suppression Act indirectly affects all growers. If they do not themselves export, their tobacco is usually consigned to an exporting warehouse, and if pests are found the grade is considerably reduced or the consignment is refused. On account of the danger of their licences being suspended, owners of commercial warehouses and grading establishments will regard with disfavour any infested or old tobacco, whether it be for export or for distribution within the Colony. This attitude of buyers and their agents is justified. Richards, writing of the possible troubles of a chocolate manufacturer, states that "a single moth or beetle flying from a cacao-store and laying its eggs in a box of chocolates just before they are sealed up may cause the makers more trouble and expense than the combined activities of 2,000,000 larvæ attacking the cacao beans."

It therefore behoves all growers and other persons handling unmanufactured tobacco to adopt the following precautionary measures, some of which are enforced under the Act:—

(1) **Speedy Disposal of Crop.**—Immediately packing has been completed, consign all the saleable tobacco to its destination. Any scrap or other loose tobacco that is to be

kept for native consumption should be stored as soon as it is sufficiently dry in an air-tight tank. The lid of the tank can be made sufficiently air-tight by inserting a large rubber gasket made of an old inner tube of a motor car tyre. A large petrol drum can be used if a hole is cut at one end, and an over-lapping lid, made of sheet iron, suitably weighted or clamped down on a rubber gasket, over the opening. The tobacco thus stored can be fumigated conveniently with carbon bisulphide at the rate of about half a whisky bottle (13 fluid ounces) per 100 cubic feet of space enclosed by the tank. This high concentration should only be used for fumigating infested tobacco, as at this strength injury may be caused to certain other products, especially seeds and plants. The amount given is a somewhat arbitrary one, but is based on sound principles of fumigation. The quantity required for a 44 gallon petrol drum is approximately 1 fluid ounce, at present prices costing about 1½d. for each fumigation. Tobacco kept for making insecticide should be stored in the same way.

The practice of keeping tobacco for use as a fertiliser is not advocated. Tobacco kept for this purpose endangers the cleanliness of store rooms from the pest control aspect and may constitute a source of disease in the fields. If it is burned immediately and the ash kept for use when required, these dangers are eliminated. But it has been indicated in tests of a preliminary nature made by the Department that this system is not practicable owing to the meagreness of beneficial results. However, if the tobacco is thoroughly mixed with manure and quickly rotted down, the danger of encouraging pests and spreading disease may he avoided.

If saleable tobacco must be stored it should be baled, and each bale wrapped in a single sheet of brown paper impregnated with tar, this wrapping being under the hessian covering. All places where the paper overlaps should preferably be sealed with an adhesive. Considerable protection from pests is thus afforded, but the possibility that the tobacco may already be infested should not be overlooked. Bales of tobacco wrapped in tarred paper should be handled with care, otherwise the paper wrapping may be torn and the protection from pests diminished.

Pay strict attention to the speedy disposal of tobacco scrap, etc., *outside the buildings or stored in neighbouring* sheds. Scrap should be burnt or disposed of as it accumulates, that is, while grading is in progress, instead of waiting until the end of the season.

(2) **Thorough Cleaning of Premises.**—After the tobacco has been disposed of, a thorough clean-up of the premises is necessary. A good sweeping giving the appearance of cleanliness is insufficient.

(a) Sweep walls and clean out all crevices. Where no danger to the building is entailed, the tops of the walls should be treated with a blow-lamp in order to kill insects hiding there. Similar treatment may be given to suspicious-looking crevices in the walls and roof. Unplastered or unpointed walls afford excellent hiding places for pests.

(b) Overhaul and clean all equipment thoroughly, scraping the dirt out of the crevices. Scraps of tobacco lying underneath the press are often overlooked and should be removed.

*(c)* Scrape *out with a pointed instrument* all *the crevices* between boards in wooden floors. Where holes are present a quantity of tobacco always collects under the floor boards. If necessary, some boards should be taken up and proper cleaning below the floor carried out. All holes in the floor should then be properly closed up, holes that admit piping, etc., not being overlooked.

(d) In short, ensure as far as possible that not a scrap of *tobacco on* which *pests can feed remains on the premises.*

Tobacco refuse, etc., deposited outside the warehouse should be totally consumed by fire or otherwise disposed of to render it unfit for consumption by insects, and the surroundings properly cleaned up.

(3) **Lime-washing Walls.**—After all tobacco and debris have been disposed of, spray the walls with hot lime-wash. A bucket pump with a long hose is useful for the purpose if equipment with a long spray rod is not available. Apply the spray with the highest pressure attainable. The lime-wash recommended at present is made by mixing quicklime gradually with water, the amount of quicklime used being

about one-third of the volume of the amount of wash made. About a pound of salt should be included in every ten gallons of spray; a little laundry blue will improve the appearance. Use the spray while it is still hot from the reaction, or, if allowed to get cold, heat it again over a fire.

(4) **Storage of other Products.**—Do not store other products in the shed during the off season, especially peanuts and peanut meal or cake. It is feared that the peanut and its products might become a favoured food of the stored tobacco worm in this country, as they are known to be elsewhere. At present in most warehouses the avoidance of pests of stored tobacco is a simple matter if proper attention is given to the precautions given above. If in the future, however, these pests develop the habit of living on products which cannot conveniently be excluded for the greater part of the year from the farm or the vicinity of the warehouse, the problem of control will become much more serious. The writer has already found one adult moth specimen of the stored tobacco worm in a private house in Salisbury, though its origin was not discovered. In this connection the farm housewife might help. Let her look to her pantry and see that no insects escape. Screened doors and windows are useful both for ventilation and for helping to keep insect pests from damaging the products of the farm. A pan of water on one of the shelves of the pantry will catch a number of insects breeding in that room.

At least a dozen pests destroying stored tobacco have been reported from various parts of the world, in addition to insects secondarily infesting this product. These latter are mostly pests of other stored products which might find their way into tobacco, and by their presence lower its value. One commonly met with is a flour beetle, *Tribolium castaneum*, Hbst., found in many kinds of meal, and, in association with other pests, in grain. Attempts to rear this insect on tobacco leaf and powdered tobacco in Salisbury have failed.

Recent experiences with the stored tobacco worm will influence buyers to suspect any insect seen on a tobacco

bale of having injured that bale, and of being capable of doing further damage.

## CONTROL OF INFESTATIONS.

**Starvation.**—The problem of eradicating pests from an infested warehouse or from infested bales of tobacco presents many difficulties. Complete disposal of all tobacco and other likely foods of the pests, followed by absolute cleanliness for a full year, will in theory, and probably in practice, ensure eradication. This, however, is only possible in special instances.

**Heat.**—*In those warehouses where Proctor machines* are used, if tobacco is put through the machine on arrival ınd immediately packed and papered on leaving the machine, the tobacco can be considered to be completely free of pests. Where there is danger of re-infestation the bales should be disposed of as early as possible, or stored in an insect-proof room immediately after packing.

Many grading warehouses have a drying room in which fairly high temperatures are attained. Their use, ıowever, in many cases is dependent on the condition of the tobacco. Where a temperature of 150 deg. F. is main-ained for two hours in the drying room there should be ıo danger of tobacco pests remaining alive, whether in the egg, larval, pupal, or adult stage, and probably half-ın-hour at this temperature would be sufficient after the tobacco has become properly heated throughout.

An infested warehouse can be cleansed and per-nanently kept clean if a system of steam heating be in-stalled. If the temperature in the warehouse be raised to .25 deg. F. and maintained for twenty-four hours or onger (e.g., Saturday night to Sunday night or Monday norning), all insect life in the warehouse with the possible xception of insects hidden deep in bales, etc., will be illed. This method is probably not suitable for use in he case of baled tobacco—the time required for the eat to penetrate into the bales is not known and in ny case such treatment may cause the moisture content of he tobacco in different parts of the bales to vary, or to nterfere in other ways with the quality of the tobacco.

This method is practised in many flour mills overseas, exhaust steam being utilised for heating purposes where steam power is employed. It has been found that one square foot of radiating surface is sufficient to heat 60 to 90 cubic feet of space to the required temperature.

As compared with fumigation, heating is cheap once the initial cost of installation has been met. Thereafter, the products of the farm are used and elaborate and costly preparations for each treatment are not necessary. Treatment "for safety's sake" can be made without undue worry over costs. There is no danger to life and the heat will penetrate to some places where poison gas will not.

**Fumigation.**—The fumigant mostly used against pests of stored tobacco in Southern Rhodesia is Hydrocyanic Acid Gas produced by the "Zyklon" method or by the pot method. For warehouse fumigation the usual household dosage is recommended. For pests in baled or bulked tobacco in a properly closed chamber the present recommendation is eight to ten times this amount, *i.e.*, at least one "1200 gram" tin of Citrus Zyklon, or 100 ounces of Sodium Cyanide with the requisite amounts of Sulphuric Acid and water, for every 1,000 cubic feet of space enclosed by the walls of the chamber. Fumigation should continue for at least 48 hours. The fumigation of bales or bulked tobacco not in a special chamber is not advised.

Overseas other useful fumigants are used, but are either not in favour or not obtainable in this Colony. For occasional fumigations it is advisable to secure the services of an expert fumigator, from whom an estimate of the cost can usually be obtained before the actual fumigation is undertaken. Where fumigation is to be carried out as an annual routine measure, full information can be obtained on application to the Chief Entomologist.

## Table Summarising Differences between the Stored Tobacco Worm and the Tobacco Beetle.

The following table, summarising some differences between *E. elutella* and *L. serricorne*, is modified from Bovingdon:—

| *Stored Tobacco Worm.* | *Tobacco Beetle.* |
|---|---|
| Egg.— | |
| Dull white and warty; 1-40 in. x 1-80 in. | Pearly white and smooth. 1-55 in. x 1-128 in. |
| Larva.— | |
| Three pairs typical jointed legs and five pairs modified legs with circlet of hooks. | Three pairs typical jointed legs only. |
| Yellowish-white with inconspicuous dark spots; not very hairy. | Yellowish-white and very hairy. |
| ½ in. long when fully grown. | 1-6 in. long when fully grown. |
| Excrement distinctly pellet-like, slightly waisted, blunt. | Excrement like tobacco dust, roughly barley-shaped, pointed both ends. |
| Larva spins silken thread. | Larva spins no silken thread. |
| Larva does not curl up when disturbed. | Larva curls up when disturbed. |
| Pupa.— | |
| About ½ in. long; generally found in folds of hessian or in crevices in casks, floor and walls. | About 1-6 in. long; generally in a pupal cell in tobacco. |
| Adult.— | |
| A typical moth; 5-8 in. across wings; dark grey or brownish-grey. | A typical beetle; 1-8 in. to 1-10 in. long; reddish-brown in colour. |
| Damage.— | |
| Irregular feeding over leaves like an ordinary caterpillar; presence of unsightly frass. | Galleries circular in section and bored through tobacco in all directions. |

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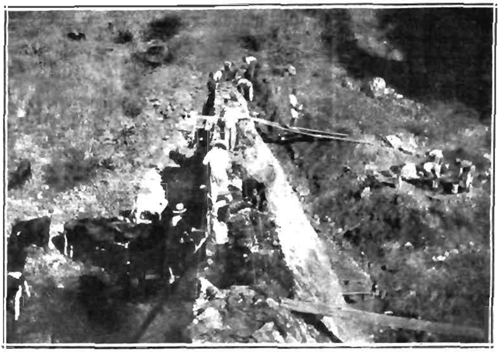
# THE BUILDING OF A SMALL STORAGE DAM.

By Neville Jones.

Having recently completed the erection of a small storage dam at Hope Fountain, I think it not unlikely that a short account of the work and its cost may be of value to others who are contemplating something similar. The rain water from a wide catchment area near the Mission Station at Hope Fountain has for many years flowed through a narrow gap in an ironstone hill and millions of gallons of water have been wasted annually. For some time past it had been my desire to erect a dam which would conserve this storm water and so provide the station with an adequate supply of water for irrigation and other purposes. A grant of £500, based upon an expert estimate, was generously made by the Arthington Trustees in England, a body particularly interested in mission work in Africa, and the work was put in hand.

The first step taken was to enlist the services of the Government Irrigation Engineer, who very kindly gave considerable time and thought to the scheme. He recommended a masonry dam of plain gravity section, which he considered would be very little more expensive and much more satisfactory than a rock-fill dam, and the cost was estimated at £500, to include a brick-lined furrow to carry water for irrigation purposes. The dam, as now completed, has an up-stream vertical face, and the down-stream face is to a batter of 2 in 3. The length of the crest is 112 feet and the width 2 feet. At each end of the crest the masonry is steeply sloped up to the rock face in order to prevent erosion at the sides when overflowing. The height of the dam is 18 feet in the centre and a 4 inch outlet pipe is provided.

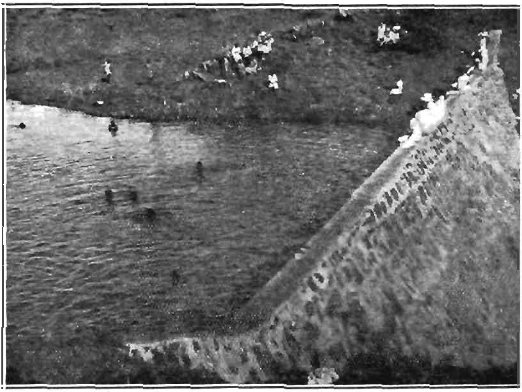
The site of the dam on the day of beginning operations



Nearing the crest.

Below the dam is a small pick-up weir 5 feet high, from which the irrigation furrow will be laid. It will act as a water cushion to receive the impact of floods from the main dam and also affords additional storage.

Great care was exercised in securing a satisfactory foundation for the structure. It was necessary to excavate to a depth of 5 feet at the bottom of the gulley in order to secure a sound rock bottom, and a good deal of stone had to



The dam partially filled. The girls of the institution enjoying a swim.

be removed from the slopes for a similar purpose. A thick bed of concrete was laid on the rock bottom and forms the foundation upon which the dam was built. For this purpose the ironstone blocks strewn in abundance on the hill-side were made use of, each block being carefully cleaned previous to being laid. Owing to the irregular fracturing of the ironstone, more cement mortar was used than was at first anticipated. This was, however, compensated for by economies in other directions which enabled the work to be completed within the estimated sum. The strength of the mortar used was 1 in 3 and the wall was pointed with

fine cement as the work proceeded. The finished work is quite water-tight, and little or no seepage appears to be taking place.

To obtain an even batter a tight line was stretched across the dam in the position ultimately occupied by the outside edge of the crest. From this line two lines, one at each end, were carried at the required batter to the foundation. Between these lines horizontal lines were run to which the native masons built. They were by this simple means able to give the batter an even and well-finished appearance. The dam took five months to complete with four native masons and twelve labourers working on it. The only difficulty encountered was the maintenance of an adequate supply of sand owing to there being none locally. The flooding of the foundations in the early stages of the work also occasioned a little inconvenience, but, as soon as the work had advanced above foundation level, a constant supply of water for building purposes became available, and a considerable saving was in this way effected.

As there is no permanent stream through the gap, the soil is naturally very dry and a great deal of the water collected in the dam since its completion has been absorbed. This will necessarily continue to take place until the ground becomes water-logged, when it can reasonably be expected to hold well. It will, however, probably be a few years before this takes place, but, with the experience gained since the completion of the work, we can reasonably hope to have a sufficient supply of water to carry us through the dry season, even allowing for the heavy evaporation.

I should like, in conclusion, to record my appreciation of the services rendered by the Irrigation Department, but for whose help I should have hesitated in embarking on a piece of work of a kind I had not hitherto attempted.

# CONTOUR RIDGES.

By R. H. Roberts, B.Sc. (Eng.), Assistant Irrigation Engineer.

A correspondent, who is a keen exponent of contour ridging and who has constructed a record mileage of ridges on his farm, asks in a recent letter for confirmation of the manner in which he has built his ridges, and it seems opportune—now that we are at the commencement of another season of the work of checking soil erosion—to discuss the points which he raises.

The first one concerns the size of the ridges and whether it could safely be reduced. When contour ridges were first built in Southern Rhodesia the scheme was naturally somewhat in the nature of an experiment, and for safety's sake the Irrigation Office recommended that they should be made three feet high and twelve or fifteen feet wide at the base. The reason for this was obvious. It was known that very heavy local rains could be expected to occur, but, in the absence of accurate knowledge of the intensity and amount of run-off, it was felt that a good margin should be allowed. Subsequent experience has led the Irrigation Division to realise that these dimensions were unnecessarily large, and that under normal conditions it is sufficient to make the ridges eight feet wide at the base and two feet high.

It is important to realise that these dimensions refer to ridges which are reasonably well consolidated in the building, and that if soil is merely shovelled into place a considerable amount of settlement is going to occur. This settlement depends on the nature of the soil and its condition (whether lumpy or well broken down) when building the ridges. A ridge built of unbroken clods will subside as much as six inches when the weather has settled the earth into a solid mass. This question of the height of the ridge is

particularly important at points where the ridge crosses an existing wash-out or small gully, and in nearly every case of broken ridges it has been found that the trouble has originated at such a place. Quite often no attempt has been made to add sufficient material to raise the bank at these low points, and it seems necessary to draw attention very strongly again to the fact that it is not sufficient only to make a ridge three feet high when crossing a wash-out one foot deep. The extra height means extra subsidence when the bank settles down, and the top of the ridge should be several inches *higher* and certainly not lower than the crest of the ridge on either side. The silt layer will always show up that sort of defect, since it lies at an even level. Cases have been inspected where the silt level was only a few inches below the top of the bank in the hollow, compared with a good foot and a half to spare a few yards away. The base width is just as important as the height, and should be increased in proportion, so that where the ridge is four feet high the width at the bottom would be fourteen feet.

This naturally means a lot more material, and it is apt to be skimped because it is more difficult to obtain earth at these places; but economy in this respect is very dangerous. Even a small wash-out will bring down a surprising quantity of silt in a single season, quite enough to level up the greater part of the hollow itself and make good the earth (largely sub-soil) taken out to build the ridge. The danger is that the silt tends to collect in a sort of dam which blocks the flow along the ridge, and if the top of the bank is not sufficiently high failure is almost certain to follow.

A very common defect frequently seen in contour ridges is that of building them to a sharp, pointed shape, quite different from the flat-topped section illustrated and described in all the recommendations of the Irrigation Division. The top width of a contour ridge is as important as the height. If a ridge is built to the correct height and sufficient width on top (two or three feet), there is very little else to worry about. The final shape of the ridge will then look after itself, since each type of soil has its own "angle of repose."

Another point raised by our correspondent related to the manner in which earth was to be obtained (using han

labour almost entirely). In his case soil had been taken from both sides of the ridge in the form of narrow and somewhat deep trenches, in order to economise both in the width of land occupied by the ridges and in good surface soil.

The objection to this procedure, of course, is that the existence of this definite deep channel tends to run off the water too quickly to allow silt to be freely deposited; but the following alternative may appeal to those farmers whose conditions permit of digging out sub-soil to a considerable depth and who wish to give up as little good land as possible. Briefly, it would consist of digging out long, narrow trenches, possibly one foot six inches deep, but *not* continuous—in other words, to dig a series of long, narrow pits, separated from each other by blocks of earth four or five feet long. These blocks would prevent the water running in a narrow, deep channel, and each pit would act as a silt trap, the filling up of which could be hastened by ploughing in a suitable manner to turn the soil back.

This method, however, is not likely to have a general appeal, since the sub-soil on most farms does not lend itself to cheap excavation. The loss of a few yards of top soil is only temporary, and if (as is known to be practised in at least one case) the denuded strip is planted to a green manure crop for the first season, the soil, with the addition of the silt deposits, will quickly come back to normal.

The great thing to aim at is to induce the water to flow in a broad, shallow stream as soon as possible after completing the ridges, and any definite deep channel will increase the velocity to a point where little if any silt will be deposited.

Most of the remarks above apply to ridges built by hand, but are just as important for ridges on which a ditching implement has been used. A certain amount of work is always required to "finish" the ridges started by a ditcher, and the work should be *carefully supervised* to make sure that the ridges are of ample height and width to allow for settlement, particularly where they cross depressions or wash-outs.

The maintenance of ridges to make good any damage they may have suffered from cattle, implements or the propensities of natives digging out rats is a matter usually

honoured more in the breach than the observance, but its importance cannot be too highly stressed. At the same time, a great deal of unnecessary patching will be saved if the ridges are properly built in the first place. The remark sometimes heard that "contour ridges are all right until the rain comes along" is only another way of saying that proper common-sense precautions have not heen taken to ensure that the ridges have been soundly made. Contour ridges built according to the simple specifications described above will stand all the vagaries of the Rhodesian rainy season.

To sum up:—

(1) Ridges should be built so that when settlement is complete they will nowhere be less than eighteen inches high, and preferably two feet.

(2) The top width of a ridge is just as important as the height, and should not be less than two feet. The other dimensions will look after themselves if you look after the height and top width.

(3) See that ridges are made extra high and wide when crossing an existing hollow. It will soon fill up with silt.

(4) Pay proper attention to maintenance, and at the beginning of each rainy season make sure that the ridges are in a good state of repair.

(5) A little trouble in building the ridges in the first place will save a lot of patching later on.

# BULAWAYO MUNICIPAL DEMONSTRATION STATION.

FINAL REPORT, 1932.

By D. E. McLoughlin, *Assistant Agriculturist.*

**Foreword.**—Work on this station was commenced in 1921, when the Municipal Council of Bulawayo acceded to a request from the writer that they would co-operate with the Department of Agriculture in providing an experimental station for Matabeleland.

The Longila Experiment Farm, near Lochard Siding, had been opened in 1912 as an experimental centre for the southern part of the Colony, but curtailed expenditure necessitated by the Great War led to its closing down in 1915. From that date until 1921 the Department was without an experimental station of any kind in Matabeleland, and in consequence was severely handicapped when called upon to advise on questions of arable farming in that portion of the Colony.

A site for the station was selected on the commonage, and the land—a red clay loam—was broken up for the first time in 1920.

Thanks to successive Town Councils and the ratepayers of Bulawayo, the station has completed ten years of very useful work, and operations on it are only discontinued since the Matopo School of Agriculture, with its resident staff of technical officers, can more conveniently conduct such investigations.

The grateful thanks of the Department of Agriculture are accorded to the ratepayers of Bulawayo, to the Town

Councillors concerned and to past and present officials of the *Council*, without all of whose continued interest the station could not have been maintained.

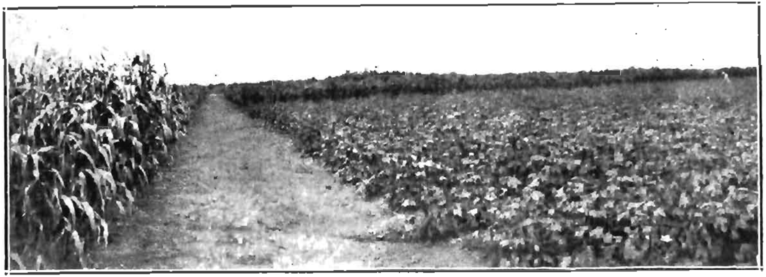
H. G. Mundy,
*Chief*, Division of Plant Industry.

Out of the ten seasons experienced at this station only three recorded a precipitation in excess of an average annual total of 21.95 inches, one verged on the normal and six were considerably below the average. The six droughty seasons averaged only a 14.33-inch rainfall, and demonstrate very well the drought-resistant character of certain crops, which renders them capable of being grown extensively in Matabeleland, notably dolichos and velvet beans, cowpeas, jack bean, and that invaluable fodder crop, Sudan grass.

Seasons entirely favourable for crop production and resulting in maximum yields would have been undesirable, and would have greatly detracted from the value of the information which has been acquired. The conditions encountered over the ten-year period may fairly be taken as no better than those which the Matabeleland farmer may normally expect to experience.

A comparison of the average yields returned by the different systems of cropping provides a useful example of what can be accomplished under local conditions if the more successful methods which have been demonstrated are adopted. Particular attention must, however, be given to autumn and winter ploughing and to preparatory tillage prior to the advent of the rains.

The many unfavourable seasons have provided a severe test of the rotational systems which have been followed, including a legume ploughed under as an alternative to farm manure, for maintaining the supply of organic matter in the soil. The sometimes depressing effect of a normal dressing of farm manure or artificial fertiliser when applied direct to the maize crop and the less damaging effect of the same application of fertiliser following a green manure crop ploughed under have been disclosed by the last four-year cycle of the rotations.



General views of plots at Bulawayo Municipal Demonstration Station.

Sudan grass in Rotation Series No. 1. Green yield per acre: first cutting, 8,968 lbs.; second cutting, 5,056 lbs. Rainfall: 17.99 inches. Bulawayo Municipal Demonstration Station.

Ground nut variety trials. Spanish Bunch in foreground: Virginia Bunch in background. Spanish Bunch yielded 18.3 bags and Virginia Bunch 23.1 bags per acre. Rainfall: 17.99 inches. Bulawayo Municipal Demonstration Station.

Velvet beans, without manure or fertiliser. Rainfall: 21.54 inches. Bulawayo Municipal Demonstration Station.

Dolichos beans, variety trials. Yield of seed: 1,007 lbs. per acre. Rainfall: 17.99 inches. Bulawayo Municipal Demonstration Station.

The following tables give the distribution of the rainfall for the season 1930-31 and for the previous nine years:—

TABLE I.

*Analysis of Rainfall: Season* 1930-31.

| Month. | No. of days on which rain fell. | Total for month in inches. | No. of rains exceeding ¼ inch. | Total to end of month in inches. |
|---|---|---|---|---|
| November ... ... | 7 | 1.75 | 1 | 1.75 |
| December ... ... | 14 | 5.41 | 8 | 7.16 |
| January ... ... ... | 7 | 3.81 | 5 | 10.97 |
| February ... ... ... | 4 | 1.57 | 3 | 12.54 |
| March ... ... ... ... | ... | ... | ... | ... |
| April ... ... ... ... | ... | ... | ... | ... |
| Totals ... ... | 32 | 12.54 | 17 | 12.54 |

*Averages for last Ten Years: Seasons* 1921-31 (*in inches*).

| Year. | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1921-22 | nil | 0.68 | 4.87 | 5.03 | 0.88 | 0.69 | 0.33 | nil | nil | 12.48 |
| 1922-23 | nil | 1.65 | 1.97 | 3.75 | 6.69 | 8.76 | 10.40 | nil | nil | 33.22 |
| 1923-24 | nil | nil | 3.00 | 1.20 | 4.17 | 4.18 | 2.70 | nil | nil | 15.25 |
| 1924-25 | nil | 0.79 | 5.15 | 10.11 | 5.09 | 6.95 | 9.91 | 3.66 | 3.41 | 45.07 |
| 1925-26 | nil | nil | 0.53 | 0.97 | 3.78 | 5.49 | 10.77 | nil | nil | 21.54 |
| 1926-27 | nil | nil | 1.27 | 4.33 | 2.61 | 4.44 | 0.44 | nil | nil | 13.09 |
| 1927-28 | nil | 1.84 | 1.50 | 4.22 | 5.58 | 0.77 | 0.64 | 0.07 | nil | 14.62 |
| 1928-29 | 0.89 | nil | 3.09 | 6.74 | 8.81 | 6.47 | 7.46 | 0.02 | 0.18 | 33.66 |
| 1929-30 | nil | 0.12 | 3.97 | 3.86 | 5.02 | 0.57 | 1.97 | 2.48 | nil | 17.99 |
| 1930-31 | nil | nil | 1.75 | 5.41 | 3.81 | 1.57 | nil | nil | nil | 12.54 |
| Average | 0.09 | 0.50 | 2.70 | 4.56 | 4.64 | 3.98 | 4.50 | 0.62 | 0.36 | 21.95 |

**Crop Rotations.**—The two four-course rotations—series "A" and "B"—demonstrate the effect on the fertility of the soil of two alternative systems of cropping. They were designed to meet the requirements of the man who follows a mixed farming system, combining live stock with the

production of cash crops. In one system the humus supply is maintained by the application of farm manure, and in the other by a legume ploughed under. Both rotational systems are well balanced, and the farmer with an insufficient supply of farm manure can safely adopt the alternative method of green manuring.

The land in each case during the four years grows two crops of maize and one of velvet beans, and one of Sudan grass (series "A") and oats (series "B").

In series "A" seven tons of farm manure are applied every fourth year to the one maize crop, while the velvet beans are reaped for green fodder or hay and the stubble ploughed in. Commencing in the season 1926-27, the maize following velvet beans reaped received 200 lbs. of superphosphate (19 per cent.) per acre.

In series "B" no animal manure is used, but the velvet bean crop is ploughed under as a green manure, and the following maize crop receives a dressing of 200 lbs. superphosphate per acre. Here again the maize following after oats has received fertiliser since the season 1926-27. Thus in the one rotation ("A") the land receives seven tons farm manure and 200 lbs. superphosphate per acre during each four-year period, while during a similar period in rotation "B" it receives one green manuring with velvet beans and 400 lbs. of superphosphate per acre.

The maize continuous experiment—series "C" and "D" —provides a check on the above rotations. In the one case (series "C") the maize has been grown year after year on the same land without any application of manure or fertiliser. In the other, series "D," four applications of 160 lbs. per acre of bone and superphosphate have been applied during the last ten years, but no organic matter has been given to the land, either by means of green manuring or farm manure.

## TABLE II.

### Rotations: Maize Yields in Bags of 200 lbs. each per Acre.

*Series "A."*

| System of cropping. | Average yield for 2nd period.* (Average annual rainfall for period 19.32 ins.) | Average yield for 1st period.* (Average annual rainfall for period 28.77 ins.) | Average yield for 8 years. |
|---|---|---|---|
| Maize, plus 7 tons farm manure per acre (after Sudan grass) ... ... ... ... | 6.81 | 14.13 | 10.47 |
| Velvet beans (green fodder) ... ... lbs. | 12,699 (3 yrs.) | 13,243 | 13,010 (7 yrs.) |
| Maize, plus 200 lbs. superphosphate per acre (after velvet beans reaped) ... ... | 7.68 | 11.54 | 9.61 |
| Sudan grass (green weight)— | | | |
| 1st cutting ... lbs. | 9,075 | 5,657 | 7,366 |
| 2nd cutting ... lbs. | 2,173 | 3,650 | 2,764 |

*Series "B."*

| System of cropping. | Average yield for 2nd period.* | Average yield for 1st period.* | Average yield for 8 years. |
|---|---|---|---|
| Maize, plus 200 lbs. superphosphate per acre (after velvet beans ploughed under) ... ... ... ... | 9.00 | 14.44 | 11.72 |
| Velvet beans ... ... ... | ploughed under | ploughed under | |
| Maize, plus 200 lbs. superphosphate per acre (after oats) ... | 7.79 | 10.63 | 9.21 |
| Oats (grain) ... lbs. | 468 | 1,056 | 762 |

* NOTE.—In 1921-22, owing to rawness of land and late planting and drought, all crops on the station were poor and were reaped for silage. In 1927-28 the rains ceased at the end of January, and again, being very poor, crops were reaped for silage. The average yields given above are, therefore, those for the four years in each period in which crops were reaped for grain.

## TABLE III.

### Maize Continuous.

*Maize Yields in Bags of 200 lbs. each per Acre.*

| System of cropping. | Average yield for 2nd period. (Average annual rainfall 19.32 ins.) | Average yield for 1st period. (Average annual rainfall 28.77 ins.) | Average yield for 8 years. |
|---|---|---|---|
| Maize continuous, *without treatment* | 2.50 | 6.34 | 4.42 |
| *Maize continuous,* plus 160 lbs. bone and superphosphate every alternate year after third year. (Fertiliser applied twice during 1921-25 and twice during 1926-30 periods) ... | 6.41 | 9.70 | 8.05 |

The results of the different manurial treatments accorded the maize crop in these cropping systems are of much interest. Reference to Table IV. which follows indicates that in seasons of low rainfall a dressing of 7 tons farm manure per acre applied direct to the maize may depress the yield. In seasons 1923-24, 1926-27, 1929-30 and 1930-31, when the total annual precipitation was less than 18 inches, the maize receiving 200 lbs. of superphosphate per acre (in series "A") exceeded the yield of the maize plus farm manure, and on an average over the four seasons by 2 bags per acre. The greatest difference to the discredit of the farm manure was in the season 1930-31, when the lowest rainfall was recorded. A rainfall of 21.54 inches in 1925-26 favoured the yield of the maize with farm manure to the extent of an increase of 6 bags per acre, but the records that season reveal that the fall of 10.77 inches for the month of March was the highest experienced in any one season out of the ten. Over the three seasons when the precipitation exceeded 33 inches there was an average increase in yield of 3 bags per acre in favour of the maize with farm manure.

In series "B" (second period), the yield of the maize following a green manure and receiving 200 lbs. of superphosphate per acre exceeded that of the maize plus farm manure by 2.19 bags per acre. Over that period the rainfall only once exceeded 18 inches, while the average over the four years was only 19.32 inches.

The beneficial effect of a dressing of 200 lbs. superphosphate per acre applied direct to the maize crop following a legume ploughed under (series "B") is well demonstrated in 1930-31 on a 12.54-inch rainfall. The yield of maize then exceeded that of the maize in the same series receiving a similar dressing of fertiliser and following oats by 2.16 bags per acre in favour of the maize following a green manure.

TABLE IV.

*Maize Yields in Rotations during Seasons with less than an 18-inch Rainfall.*

| Treatment. | Seasonal Rainfall. 1930-31: 12.54 ins. | 1929-30: 17.99 ins. | 1926-27: 13.09 ins. | 1923-24: 15.25 ins. | Total yield, 4 seasons. |
|---|---|---|---|---|---|
| Series "A"— | | | | | |
| Maize, plus 7 tons farm manure per acre (after Sudan grass) ... ... ... ... | 2.01 | 7.15 | 4.07 | 10.00 | 23.23 |
| Maize, plus 200 lbs. superphosphate per acre (after legume reaped) ... | 4.29 | 8.30 | 6.03 | 12.25 | 30.87 |
| Series "B"— | | | | | |
| Maize, plus 200 lbs. superphosphate per acre (after legume ploughed under) ... ... ... ... | 5.66 | 6.92 | 7.02 | 13.50 | 33.10 |
| Maize, plus 200 lbs. superphosphate per acre (after oats) ... ... ... ... ... | 3.50 | 6.90 | 6.45 | 8.15 | 25.10 |
| Series "C" and "D"— | | | | | |
| Maize continuous without fertiliser | 1.26 | 1.42 | 1.56 | 6.00 | 10.24 |
| Maize, plus 160 lbs. bone and superphosphate per acre every alternate year after third year ... ... | 5.04 | 6.60* | 2.61 | 6.00 | 20.25 |

* Fertiliser applied direct to maize in 1929-30.

The relative effect of the different treatments over the four seasons experiencing a rainfall of under 18 inches is reflected by an increased total yield of 9.87 bags from the maize following a green manure crop ploughed under as compared with the maize receiving 7 tons per acre of farm manure, and of 2.23 bags an acre compared with the yield of the maize plus fertiliser following a legume *reaped;*

while over the same four years the yield of the maize with fertiliser after a legume reaped exceeded that of the maize with farm manure by 7.64 bags.

The yields in series "A" and "B," where organic matter is supplied by means of farm manure or green manuring, exceed that of the continuous maize receiving 160 lbs. bone and superphosphate four years out of eight by over 2 bags per acre, and exceed the yield from the maize continuous plot without fertiliser by nearly 6 bags per acre.

The fact that over a series of exceptionally dry seasons the benefits of green manuring have been fully maintained is contrary to the experiences of many other countries, bnt in these experiments as well as in those carried out at the Agricultural Experiment Station, Salisbury, the practice has invariably been best rewarded in years of inadequate rainfall.

The results recorded here afford striking proof that green manuring can be recommended for Matabeleland as unreservedly as it can under the more humid conditions of Mashonaland.

**Maize Fertilised Direct versus Fertiliser applied to the Preceding Legume Crop.**—Here the system of cropping is maize following cowpeas and maize following velvet beans. The object of this experiment was to compare, under local conditions of soil and climate, the effect on the maize crop of applying the normal dressing of phosphatic fertiliser to the maize crop direct as against applying it to the preceding legume crop which is reaped for hay.

The results over a period of three years indicate that when the fertiliser was applied to the preceding legume crop the maize yield was greater in the season 1929-30 by 3.3 bags, and in the season 1930-31 by 2.21 bags per acre. In both seasons the rainfall was considerably below normal. In 1928-29, when the rainfall was 33.66 inches and above normal, the difference was one of 3 bags per acre in favour of the maize receiving fertiliser direct.

When the fertiliser was applied to the preceding maize crop the average yield of legumes was greater by 6,864 lbs. (green weight) over the first two seasons, but in 1930-31 the difference was in favour of the direct application.

The point which seems to emerge here is that on this class of land, which does not retain moisture too well in seasons experiencing a low rainfall, a normal direct dressing of fertiliser may—and, indeed, is likely to—have a distinctly detrimental influence on the maize crop, unless the organic matter supply in the soil has been well maintained. If these conditions have not been complied with, a wise precaution would seem to be to apply half the normal dressing of artificials each year instead of a larger amount every other year.

**Linseed.**—This crop requires only three months to reach maturity and is, therefore, a useful catch crop in seasons experiencing late rains. It seldom fails to produce a moderate return of seed in Matabeleland. The best yield obtained was in 1924-25, when 532 lbs. per acre were reaped from the white-flowered variety. Linseed is a valuable feed for pedigree stock and young calves, and since the seed is expensive to buy, it can more profitably be produced on the farm. It is a heavy feeder and should be grown on fertile soil.

*Linseed Variety Trials.*

| Variety. | 1930-31 (lbs. per acre). | Average (lbs. per acre). |
|---|---|---|
| White flowered ... ... ... ... | 240 | 278 (7 years) |
| Large seeded ... ... ... ... | 304 | 231 (4 years) |
| Yellow seeded ... ... ... ... | 432 | 432 (1 year) |
| Small seeded ... ... ... ... ... | 352 | 352 (1 year) |

**Ground Nut Variety Trials.**—The results of these trials have been as follows:—

*Ground Nut Variety Trials.*

| Variety. | Yield per Acre (bags of 75 lbs.). 1930-31. | Average Yield per Acre (bags of 75 lbs.). |
|---|---|---|
| Spanish Bunch ... ... ... ... | 13.2 | 16.8 (4 years) |
| Virginia Bunch ... ... ... ... | 5.7 | 11.9 (4 years) |
| Virginia Runner ... ... ... ... | — | 14.1 (1 year) |
| Japanese Bunch ... ... ... ... | — | 12.8 (1 year) |
| Jumbo ... ... ... ... ... ... | — | 7.2 (1 year) |

Virginia Bunch has consistently given a lower yield than Spanish Bunch, except in 1929-30, when conditions permitted of it being planted a good deal earlier than is usually possible. It requires a two to three weeks' longer growing season than

does the Spanish Bunch variety, and for this reason it is not generally so well suited to Matabeleland conditions.

**Maize Variety Trials.**—The object here has been to determine the varieties which are most suitable to local conditions of soil and climate. No definite rotation has been followed in these trials, but each season the varieties were planted on the same day, received the same manurial treatment and were planted the same distance apart. As far as possible, seed of locally-grown strains was used. Seed of the four standard Rhodesian varieties was supplied each year by recognised growers in Mashonaland. The experiments extend over a period of seven years. Four seasons out of seven recorded a rainfall below normal. In accordance with the general practice, maize was planted in moist ground and at a date when the rains appeared to have well set in. In all, 18 varieties have been tested, including importations from the Union of South Africa and the United States of America, but on account of their low yield or susceptibility to maize blight, many of these were periodically eliminated. The tests were finally reduced to the four standard white dent varieties of Rhodesia and the most promising local acclimatised strains of yellow and white flints.

Despite the fact that seed of the former varieties had each year been grown in an environment (Mashonaland) very different to that of Matabeleland, they out-yielded the early maturing varieties (Matabeleland seed) by 2¼ bags per acre, and this in spite of the early frosts and unusually light rainfall of several of the seasons.

In only one season out of the seven, namely, in 1927-28, when the rains ceased at the end of January, did the early flint varieties show any superiority over the white dents. In no other season, even with a rainfall well below normal, but recording rain throughout February, was there any difference in favour of early flint varieties.

From the returns already quoted it is apparent that even in those seasons experiencing a rainfall of less than 18 inches satisfactory yields can be obtained in Matabeleland from the standard white dents if grown under good farming conditions, while, should the rainfall exceed the normal, then considerably heavier crops will be returned by these than by any

earlier maturing strain yet introduced. The conclusion may be drawn that, except in very dry areas, when conditions permit of planting by the 20th December, no advantage will usually be secured by substituting early flint varieties for white dents. If planting must be delayed until after Christmas, resort to early varieties is advisable.

Quick maturity is not generally associated with high yield, and there is room for the breeding of a variety for Matabeleland which is somewhat quicker to mature than Salisbury White or Potchefstroom Pearl, which will maintain a high yielding character and which at the same time will be resistant to maize blight.

The maintenance of sufficient organic matter in the soil and good preparatory tillage, particularly autumn and early winter ploughing, and thorough cultivation to suppress weeds, are the factors of chief importance in crop production in Matabeleland, for in areas of somewhat uncertain rainfall the essential precautions are (1) to be prepared to plant immediately the combined state of the land and the weather conditions permit, and (2) to absorb and retain for useful purpose as great a proportion of the precipitation as possible. Neither of these provisos can be complied with by the farmer who awaits the first soaking rains of the season before commencing to plough and prepare his lands.

Experience on this station would indicate that, providing the land has been well ploughed, is in good heart and is subsequently cultivated to conserve the moisture, an inch of rain in December will tide the maize crop over a period of three weeks without further rain.

*Variety Trials.*

Average of Duplicate Plots.

| Variety. | Average Yield per Acre (in Bags of 203 lbs.) over 7 years. |
|---|---|
| Louisiana Hickory | 8.80 |
| Potchefstroom Pearl | 8.48 |
| Hickory King | 8.45 |
| Salisbury White | 8.40 |
| Yellow Flint | 6.64 |
| American White Flint | 6.33 (4 years) |
| Sahara Yellow | 6.9 (2 years) |
| Golden Beauty | 6.8 (2 years) |

Other varieties tried and discarded for various reasons—usually extreme susceptibility to maize blight—are Krug, Wisconsin White Dent, Iowa Silver Mine, Eureka, Menna, German Yellow, Yellow Cango, Pride of Saline and Minnesota No. 133.

**Legumes for Fodder and Grain.**—During the last ten years some thirty varieties of legumes have been tested on this station, and the extreme wet and dry seasons experienced over that period have afforded a good opportunity of thoroughly testing out these crops for cultivation on a large scale. Many have proved very tolerant of drought and can be relied on even in the driest of seasons to provide a good supply of fodder, while, in seasons of ample rainfall, their growth is most luxuriant.

In addition to their value as a feed for stock, their cultivation in a suitable rotation with maize or other grain crops aids in maintaining the fertility of the soil, and they should always, therefore, be included by every farmer desiring to practise a sound system of arable cropping. Dolichos beans, velvet beans, jack beans and cowpeas are all valuable as green manure crops, and though sown for this purpose they may, if drought is experienced, be utilised for feed.

The respective qualities of the different legumes have been discussed in previous reports. In view of the results obtained with the white jack bean during the last two seasons on this station, as well as those given by it at the Salisbury Experiment Station, the crop seems deserving of more attention. This bean makes luxuriant upright growth and is remarkably drought-resistant. Its foliage, which is well supported on stout stems, is of bushy nature, and it keeps green after most of the other legumes have dried off.

In 1929-30 on an 18 inch rainfall it returned the greatest yield of grain of all legumes, and in 1930-31 on 12.5 inches its yield was exceeded only by that of dolichos beans. It would appear from results obtained elsewhere in the Colony that it seeds more heavily in rather dry than in wet seasons.

*Yield of Legumes for Fodder.*

| Crop. | 1930-31. Lbs. per Acre (green weight). | Average Yield. Lbs. per Acre (green weight). | Period in Years. |
|---|---|---|---|
| Dolichos beans ... ... ... | 12,505 (5 plots) | 11,498 | 7 |
| Velvet beans ... ... ... | — | 11,331 | 6 |
| Cowpeas (common) ... | — | 8,265 | 5 |
| Cowpeas (iron) ... ... | — | 8,265 | 5 |
| Soya bean ... ... ... ... | 5,572 (4 plots) | 5,572 | 1 |

TABLE V.

*Yield of Legumes for Grain.*

| Variety. | Average Yield to Date (lbs. per acre). | Period in Years. |
|---|---|---|
| Velvet Beans— | | |
| White Stingless ... ... ... ... ... ... ... | 730 | 7 |
| Tracey's Early Black ... ... ... ... | 524 | 2 |
| Osceola ... ... ... ... ... ... ... ... ... | 462 | 2 |
| Somerset ... ... ... ... ... ... ... ... | 279 | 1 |
| Variety 30/26 ... ... ... ... ... ... | 359 | 1 |
| Florida ... ... ... ... ... ... ... ... ... | 525 | 3 |
| *S. taborense* ... ... ... ... ... ... ... | 375 | 1 |
| Dolichos Beans— | | |
| Small Brown Seeded ... ... ... ... | 530 | 6 |
| White Seeded ... ... ... ... ... ... | 84 | 1 |
| Indian ... ... ... ... ... ... ... ... ... | 737 | 1 |
| Ewanrigg ... ... ... ... ... ... ... ... | 186 | 1 |
| Tepary Beans ... ... ... ... ... ... ... ... | 281 | 4 |
| Kaffir Bean (common) ... ... ... ... ... | 506 | 2 |
| Cowpeas— | | |
| New Era ... ... ... ... ... ... ... ... ... | 715 | 3 |
| Common Iron ... ... ... ... ... ... ... | 672 | 7 |
| Whip-poor-will ... ... ... ... ... ... | 477 | 6 |
| Upright Iron ... ... ... ... ... ... ... | 150 | 1 |
| Victor ... ... ... ... ... ... ... ... ... | 105 | 1 |
| Brabham ... ... ... ... ... ... ... ... | 240 | 2 |
| Monetta ... ... ... ... ... ... ... ... | 213 | 2 |
| Dhal ... ... ... ... ... ... ... ... ... ... ... | 395 | 4 |
| Sunn Hemp ... ... ... ... ... ... ... ... | 517 | 7 |
| Chick Pea or Gram ... ... ... ... ... | 328 | 1 |
| Canadian Wedge Pea ... ... ... ... ... | 422 | 2 |
| White Jack Bean ... ... ... ... ... ... | 849 | 2 |
| Soya Beans— | | |
| Oo-too-tan ... ... ... ... ... ... ... ... | 460 | 1 |
| Herman ... ... ... ... ... ... ... ... ... | 487 | 1 |
| Biloxi ... ... ... ... ... ... ... ... ... ... | 289 | 1 |
| Chinese ... ... ... ... ... ... ... ... ... | 345 | 1 |
| Laredo ... ... ... ... ... ... ... ... ... ... | 384 | 1 |

**Silage Crops.**—The absence of green herbage in all districts of the Colony during the dry winter months and up to October or later makes it imperative that the farmer should provide a suitable substitute, and the undermentioned results with silage crops demonstrate the success with which they

can be grown in Matabeleland. A crop which until recently has received little attention for this purpose is the natural veld grass. Experiments have proved that green grass retains most of its nutritive value after being ensiled. This being the case, the quantity of green grass usually available and the easy manner in which it can be handled render it a tremendous asset to the live stock farmer.

No matter, however, what reliance may be placed on veld grass silage, most farmers will also deem it expedient to grow special crops for conversion into this product, and the following records are, therefore, informative:—

## TABLE VI.

*Yields per acre in lbs. (Green Fodder).*

| Crop. | How sown. | Yield, 1930-31. (Lbs. per acre green fodder.) | Average yield to date. (Lbs. per acre green fodder.) | Period in years. |
|---|---|---|---|---|
| Sunflower and Velvet Beans ... ... ... ... ... ... | 36 x 9 (same row) | 18,724 | 19,121 | 8 |
| Sunflower and Velvet Beans ... ... ... ... ... ... | 20 x 18 (alternate rows) | — | 16,339 | 4 |
| Sunflower alone ... ... ... | 30 x 12 | 10,540 | 19,162 | 8 |
| Maize and Velvet Beans | 36 x 9 (same row) | 10,168 | 12,823 | 8 |
| Maize and Velvet Beans | 20 x 18 (alternate rows) | — | 13,570 | 4 |
| Maize alone ... ... ... ... ... | 30 x 12 | 9,858 | 13,838 | 8 |
| Kaffir Corn and Velvet Beans ... ... ... ... ... ... | 36 x 9 (same row) | — | 8,721 | 3 |
| Kaffir Corn and Velvet Beans ... ... ... ... ... .. | 20 x 9 (alternate rows) | — | 14,216 | 3 |
| Kaffir Corn alone ... ... | 24 x 9 | 15,088 | 12,585 | 7 |
| Maize and Cowpeas ... | 36 x 9 (same row) | — | 12,772 | 1 |
| Maize and Dolichos Beans ... ... ... ... ... ... | 36 x 12 (same row) | 20,894 | 20,894 | 1 |
| Sunflower and Dolichos Beans ... ... ... ... ... ... | 36 x 12 (same row) | 11,780 | 11,780 | 1 |
| Sudan Grass ... ... ... ... ... | Broadcast (in Rotation "A") | 10,130 | 10,130 | 8 |

Sunflowers either alone or combined with one of the legumes are a dependable silage crop for Matabeleland, and though the silage is less palatable than that made from maize, the yield per acre is greater. On farms where kaffir corn is known to thrive, this will combine well with velvet beans or dolichos beans, while the merits of sudan grass as an easily handled silage or hay crop deserve much more attention than they receive.

**Sweet Potato.**—The most reliable succulent winter feed for Matabeleland is undoubtedly the sweet potato, but again little attention is yet paid to this valuable crop. It has proved a success in both wet and dry seasons. A heavy rainfall and long growing season are favourable to a heavy yield of tubers and top growth, but in no part of Rhodesia below 5,000 feet altitude is the season too short or the rainfall too scanty to permit of sweet potatoes being grown.

Where the season often is short, it has been found more profitable to refrain from lifting the tubers the first year, or, in other words, to establish the crop with the idea of not lifting the tubers until eighteen or twenty months later. One of the most practical methods of carrying out this system is to establish the cuttings between the rows of a maize crop after the final cultivation, in late January. On the other hand, on well manured land specially set aside for the crop, it can be planted 36 x 18 inches apart, and if established not later than the middle of December should produce a reasonable amount of tops and tubers by the following May or June. The advantages of the sweet potato are:—(1) The tubers can be left in the ground and lifted when required; (2) the tops can be fed green or grazed in late autumn and early spring when green grass is scanty or entirely lacking; (3) by feeding the tubers to dairy cattle, fattening bullocks or pigs, the grain ration required can be appreciably reduced.

The Early Butter variety, by reason of its shorter growing period, has proved the heavier yielder of tubers, and since its combined weight of both tubers and tops is about equal to that of the Calabash Leaf variety, it would appear to be the more suitable variety to grow as a stock feed in Matabeleland.

*Sweet Potatoes.*

Cuttings planted one Season, and Crop lifted at End of following Season.

| Variety. | Average Yield over 6 Years (in lbs. per acre). Tubers (5 years only). | Green tops. |
|---|---|---|
| Calabash Leaf ... ... ... | 9,356 | 16,765 |
| Early Butter ... ... ... | 13,514 | 12,434 |

Grown from Cuttings (planted and lifted the same Season).

| Variety. | Average Yield per Acre (4 years). |
|---|---|
| Calabash Leaf ... ... ... ... ... ... ... ... ... ... ... | 7,996 |
| Early Butter ... ... ... ... ... ... ... ... ... ... ... ... | 5,832 |

**Oats.**—Several varieties of oats suitable for sowing in the rainy season have been tried on the station during the ten years, but the crop is intolerant of droughty conditions, and is, therefore, much more uncertain than others referred to more fully in this report.

*In spite of not infrequent seasons of* low rainfall, Matabeleland as a whole—*given* reasonably *good farming*—can grow as wide a range of grains and fodders as will be needed by the average farmer who makes the marketing of his produce on the hoof his primary concern.

# MIXING OF FERTILISERS.

## A GUIDE TO METHODS OF CALCULATION.

By the DIVISION OF CHEMISTRY.

At the outset we wish to make it perfectly clear that in this short article we have no intention whatsoever of advising farmers to make a habit of mixing their own fertilisers from the primary ingredients. Theoretically, this may save a few shillings, but there are two considerations which must be taken into account. On the one hand, no farmer possesses the efficient machinery of the fertiliser firms, so can never hope to emulate the perfection of their mixtures. On the other hand, with unskilled native labour, constant white supervision is necessary, so that on both grounds the practice may well turn out to be a waste instead of an economy. These firms charge only a small percentage for mixing, and their final products are uniformly up to standard. This is evidenced by the closeness with which their mixtures invariably approach the guaranteed composition on being analysed by the Government analysts, so that in the end a farmer is well repaid for the small extra charges. He is always sure of getting good value, and need never be afraid that the mixture he buys is below what is stated in the catalogues, for he is fully protected by the "Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance, 1914."

There are, however, occasions when it may pay a farmer to mix for himself. Owing to the recent depressed conditions, and the fact that several farmers have gone—temporarily, we hope—out of business, stocks of unused fertilisers from previous years have frequently been for sale of late at greatly reduced prices, and it certainly would be profitable for neighbouring farmers to purchase these and mix with others to suit their own requirements.

During this past year, we have had numerous requests from farmers telling us that they had acquired a stock of this fertiliser, or that, or several, at reduced prices, and asking us to advise them how to mix them, or in what proportion to mix them with others, which they were prepared to buy from the fertiliser firms, in order to make a particular mixture to suit some special crop or soil.

We have also had enquiries from some who felt from experience that none of the stock mixtures from the local firms was quite suited to the crop they wished to grow, or, it might be, to the soils on their farms. Some, indeed, wish to experiment with entirely new mixtures, and, realising that extra charges must necessarily be made for the preparation of a small lot of a special mixture, decide to purchase the basic elements and mix themselves.

All these are justifiable and worthy of encouragement, and it is to assist in the very simple calculations necessary to determine the proportions of the ingredients that these short notes are written.

It is necessary, however, particularly to those without chemical knowledge, to give a word of warning that there are grave dangers of losing valuable fertilising ingredients or of rendering the finished fertiliser physically unfit for application if certain mixtures are made. The former defect is liable to occur through harmful chemical action taking place whereby valuable plant food is lost, the latter usually through moisture being absorbed from the air, causing the final mixture to consolidate into hard blocks, or to become sticky and impossible of uniform application. There is also a danger in mixing heavy large-grained simple fertilisers with exceedingly fine-grained ones that the latter will separate out leaving the other on top, with the result that no homogeneous mixture of these can ever be effected by home-made methods.

This being so, it is only a matter of common precaution to know definitely which of the common fertilisers may safely be mixed and which may not. In any event, even with fertilisers which may safely be mixed without chemical action taking place, it is safer always to mix just before using. For example, although there is no objection from a chemical point of view to mixing muriate of potash with

superphosphate, if the final product is left for more than a few hours, it will become quite wet, sticky and almost impossible to distribute.

The three following simple rules form a safe guide with the fertilisers commonly in use in this Colony. It may be observed, however, that even these may be disregarded if the mixture is completed just *immediately* before applying, when little loss will be incurred.

1. Never mix lime or any fertiliser containing free lime (such as basic slag) with any fertiliser containing its nitrogen in ammoniacal form (such as sulphate of ammonia).

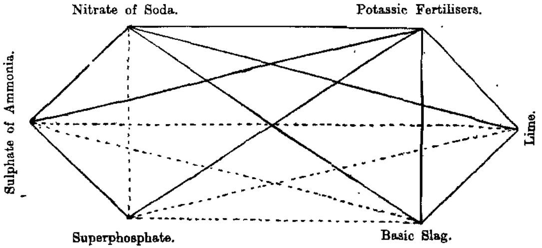
Chemical action causes the ammonia to be set free, with the consequent loss of valuable nitrogen.

2. Never mix lime or any fertiliser containing free lime with any phosphatic fertiliser containing all or a part of its phosphates in water-soluble form (such as superphosphate).

Chemical action causes the water-soluble phosphate to revert to a more insoluble form, with a consequent inferior distribution among the soil particles.

3. Never mix nitrate of soda with superphosphate, for chemical action sets in causing evolution of nitric acid, with a consequent loss of nitrogen.

The following little diagram, copied from "Elementary Agricultural Science," by William Smith, M.A., B.Sc. (Agric.), gives a clear picture of which are safe and which are unsafe mixtures.




———————— Those which may be mixed.

— — — — — Those which may *not* be mixed.

*We shall now give examples of the methods of calculation employed in preparing required mixtures from certain* known and available ingredients.

1. Suppose a farmer has a stock of 20 per cent. superphosphate and he wishes to mix this with sulphate of ammonia (20 per cent. nitrogen) and muriate of potash (60 per cent. potash) to obtain a complete fertiliser, say of composition 15 per cent. phosphoric oxide, 3 per cent. nitrogen and 5 per cent. potash.

| | $P_2O_5$ | N | $K_2O$ |
|---|---|---|---|
| In 100 lbs. mixture we require ... ... ... | 15 | 3 | 5 |
| To get 15 lbs. $P_2O_5$ we must use $\frac{15 \times 100}{20} = 75$ lbs. superphosphate | 15 | — | — |
| To get 3 lbs. N we must use $\frac{3 \times 100}{20} = 15$ lbs. sulphate of ammonia | — | 3 | — |
| To get 5 lbs. $K_2O$ we must use $\frac{5 \times 100}{60} = 8.3$ lbs. muriate of potash | — | — | 5 |
| | 15 | 3 | 5 |

Therefore to make a ton we must mix—

20 x 75 = 1,500 lbs. superphosphate.

20 x 15 = 300 lbs. sulphate of ammonia.

20 x 8.3 = 167 lbs. muriate of potash.

33 lbs. filler.

2,000

A suitable filler is fine sand, of which supplies are usually readily obtainable. Raw rock phosphate might be used in some cases where an increase in the phosphoric oxide content would be of value and would not materially upset the balance of the mixture. This compound would be equally as effective

as sand in obtaining a dry composite mixture. In a mixture such as the above the quantity of filler is so small that it might be omitted without the composition of the resulting product being appreciably altered.

2. Requests have been received from farmers who have purchased supplies of concentrated complete mixtures and who desired to add single ingredients to these in order to bring the resulting product to the composition of some well-known fertiliser. Suppose it is desired to reduce a fertiliser "A" containing 25 per cent. phosphoric oxide, 12 per cent. nitrogen and 15 per cent. potash to one approximating a complete fertiliser of the composition 20 per cent. phosphoric oxide, 4 per oent. nitrogen and 6 per cent. potash.

| | $P_2O_5$ | N | $K_2O$ |
|---|---|---|---|
| In 100 lbs. mixture we require ... ... ... | 20 | 4 | 6 |
| To get 4 lbs. N we must use $\frac{4 \times 100}{12} = 33\frac{1}{3}$ lbs. compound "A" | — | 4 | — |
| This being one-third of 100 also gives $\frac{1}{3} \times 25 = 8.3$ lbs. $P_2O_5$ ... ... | 8.3 | — | — |
| and $\frac{1}{3} \times 15 = 5$ lbs. $K_2O$ ... ... ... ... | — | — | 5 |
| Now use 17.5 per cent. superphosphate for remaining 11.7 lbs. $P_2O_5$ $\frac{11.7 \times 100}{17.5} = 66\frac{2}{3}$ lbs. approximately | 11.7 | — | — |
| | 20 | 4 | 5 |

To make a ton we must mix—

$20 \times 33\frac{1}{3} = 667$ lbs. compound "A."

$20 \times 66\frac{2}{3} = 1{,}333$ lbs. 17.5 per cent. superphosphate.

2,000

That is one part given compound and two parts superphosphate.

Raw rock phosphate is often used in reducing such compounds. In this way the high phosphoric oxide content is maintained, although the water-soluble portion is much diminished. One part of the above compound and two parts raw rock phosphate would give a mixture of composition 30 per cent. phosphoric oxide, 4 per cent. nitrogen and 5 per cent. potash. In this only 8.3 per cent. phosphoric oxide would be water-soluble.

3. A final example is given showing how a complete mixture with the various components in a definite desired proportion may be obtained. Suppose the well-known tobacco fertiliser of composition 20 per cent. phosphoric oxide, 7 per cent. nitrogen and 10 per cent. potash is required. Further, suppose that 4 per cent. of the nitrogen must be in the form of ammonia and 3 per cent. as nitrate, and that 6 per cent. of the potash be sulphate and 4 per cent. muriate. The ingredients necessary will be:—

(1) A concentrated compound containing phosphoric oxide and nitrogen. There are several such compounds on the market containing the nitrogen in the form of ammonia. Suppose we have one with 50 per cent. phosphoric oxide and 10 per cent. nitrogen: Compound "B."

(2) Sulphate of ammonia to complete, if necessary, nitrogen content as ammonia (20 per cent. nitrogen).

(3) Nitrate of soda to give nitrogen as nitrate (16 per cent. nitrogen).

(4) Sulphate of potash to give potash as sulphate (48 per cent. potash).

(5) Muriate of potash to give potash as muriate (60 per cent. potash).

| | $P_2O_5$ | N | $K_2O$ |
|---|---|---|---|
| In 100 lbs. mixture we require ... ... ... | 20 | 7 | 10 |
| To get 20 lbs. $P_2O_5$ we must use $\frac{20 \times 100}{50}$ = 40 lbs. Compound "B" ... | 20 | — | — |
| This also gives $\frac{40 \times 10}{100}$ = 4 lbs. nitrogen as ammonia ... | — | 4 | — |
| This supplies all the ammoniacal nitrogen, so no sulphate of ammonia is required. | | | |
| To get 3 lbs. N as nitrate we must use $\frac{3 \times 100}{16}$ = 17.75 lbs. nitrate of soda | — | 3 | — |
| To get 6 lbs. $K_2O$ as sulphate we must use $\frac{6 \times 100}{48}$ = 12.5 lbs. sulphate of potash | — | — | 6 |
| To get 4 lbs. $K_2O$ as muriate we must use $\frac{4 \times 100}{60}$ = 6.7 lbs. muriate of potash | — | — | 4 |
| | 20 | 7 | 10 |

Therefore to make a ton we require—

| | | |
|---|---|---|
| 20 x 40 | = 800 lbs. | Compound "B." |
| 20 x 17.75 | = 355 lbs. | nitrate of soda. |
| 20 x 12.5 | = 250 lbs. | sulphate of potash. |
| 20 x 6.7 | = 133 lbs. | muriate of potash. |
| | 462 lbs. | filler. |
| | 2,000 | |

It is hoped that these examples will be of value in enabling farmers who contemplate preparing their own mixtures to make their preliminary calculations, but, if difficulties are still encountered, the advice of the Division is always available, and will be gladly given.

# *ALEURITES FORDII* (THE TUNG OIL TREE).

The following extracts are taken from Bulletin 221 of the University of Florida Experiment Station:—

*Drainage.*—Without sufficient drainage the trees will not continue to show a thrifty and satisfactory growth, irrespective of other cultural attentions given them. Surface drainage only is not sufficient; the water table must be considerably below the soil surface level.

*Propagation.*—The common practice is to plant seeds in a nursery bed in early spring, the seedlings being transplanted to permanent field positions after one season's growth. The nursery method seems to be preferable to planting seeds directly in the field where the trees are wanted in that the cost of required cultivation for the same number of trees is almost negligible in the nursery as compared with field plantings.

The seeds do not remain viable over an extended period and, if to be used for planting purposes, must be planted during the season following their maturity. In the nursery row they are planted at a depth of 2 to 4 inches, spaced 8 to 12 inches apart in the row, with the rows not closer than 3 feet. Approximately 60 days are required for germination. Hulled seeds only should be planted, as the planting of whole fruits results in a cluster of more or less spindling and malformed seeds which, because of their crowded condition, do not develop into straight, vigorous stock.

Frequent and shallow cultivation should be given from the time the seedlings appear until midsummer.

Complete commercial fertilisers, barnyard manures, and varying forms of nitrogenous fertilisers have all been used to advantage in the growing of the young trees. One or two applications are made, the first after the seedlings are a few inches high and the second in early summer.

*Transplanting and Cultivation.*—In general the same methods are used in transplanting tung-oil trees from the nursery to the grove as with other fruit or nut trees.

In this connection, the question of the distance to plant naturally presents itself. As there are no mature groves of tung-oil trees in the United States, the answer to this question is yet largely problematical. On the strength of the size attained by the trees in China some have recommended that they be planted as close as 20 feet each way. However, it seems that this is too close for Florida conditions, where, with good care, the trees apparently exceed in size those in China. It should be remembered that the latter are practically uncultivated, receive little or no fertiliser, and are said to grow upon the poorest of soils.

It would seem best, in the light of present information, to set the trees 25 x 25, 25 x 30, or even 30 x 30 feet apart. However, in order to economise in the matter of cultivation and care it appears entirely practical to plant trees, say, 25 or 30 feet one way, and half this distance the other, with a view to transplanting alternate trees to other groves when they become crowded. There is every reason to believe that trees several years of age can be transplanted successfully, if as great care be observed, for example, as in transplanting large citrus trees.

In setting the trees it is of utmost importance that they are not planted too deeply. The proper depth is that at which they stood in the nursery row, and if planted much deeper it may be the cause of failure in these trees.

All malformed nursery stock or trees which have become stunted from any cause will ordinarily fail to grow into vigorous field trees irrespective of later attention given. A rigorous grading and discarding of all nursery stock below a high standard is of utmost importance as an initial step towards a thrifty permanent planting.

*Pruning.*—Pruning of older trees, other than the removal of dead, broken, or interfering branches, seems to be of no advantage and unnecessary. Due to the manner of fruiting, the fruit being borne only on twig terminals of the previous season's growth, any pruning evidently tends to reduce the number of fruiting twigs, with a consequent reduction of yields.

# FARMING CALENDAR.

## April.

### BEE-KEEPING

The notes given for last month will in the main apply to April also, according as to how the season develops. New swarms are not recommended to be hived during this month unless they are supplied in the first instance with fully drawn out frames and the owner is prepared to feed them now and again during the winter. As April should be a very active month for the bees, watch carefully the progress of the crates in which surplus honey is being stored, and have plenty of frames—fully drawn out if possible—ready fixed with foundation so as to place on extra crates as occasion may require; these should be placed under the full or filling one and not on the top, as might appear the case. For the benefit of those who would like a little honeycomb, it might be stated that if two or three shallow frames are fitted with four empty comb sections, and placed in the crate, the bees will take to this plan and so provide both comb and honey for extraction in the one crate. In this African climate full crates can be left on the hive with safety until ready for extraction, but if any are taken off they must be watched now and again until they are extracted for damages from the wax moth, which in a day or so can ruin both the comb and honey.

### CITRUS FRUITS.

During the first half of this month, autumn budding can still be performed if the sap is still up and the bark of the stock slips freely. Unprofitable and off type trees that have been headed back for top working and which have been carefully thinned out may have the shoots on which February-March buds have failed re-budded to profitable varieties. If the March rains have been sufficient and ploughing and cultivation have been completed, continue cultivation to retain soil moisture and destroy winter weeds. If a dry March has been experienced and cultivation has been badly performed, irrigation should be commenced or continued to keep the trees and fruit in good order. If not already applied to the unthrifty trees which are late with their autumn flush, soluble fertilisers containing nitrogen and phosphoric oxide can be applied with advantage to these trees. The fertiliser should be worked into the soil with a cultivator and followed up with an irrigation. Exporters should have everything in readiness for packing the early fruit, which should be fit to market about the end of the month. Scale infested fruit will be unfit for export unless treated at once. See entomological notes for treatment.

### CROPS.

If sufficiently mature, begin cutting and stooking early maize over a small acreage and plough up the ground whilst still damp between the rows of stooks. If ripe, reap and husk early planted maize, and keep in a separate dump. Continue to make field selections of the best maize plants, and mark those required for seed with strips of coloured cloth. Lift any ground nuts and potatoes showing signs of making second growth. Make silage; cut maize for this when the ears are in the "dough" stage.

Pick up and stook maize plants blown over to protect the ears from white ants. Feed sweet potato vines to stock, reserving any new growth of vines for feeding as grazing in May. Plough in any green manure crops not already turned under. Plough fallowed land. Keep potatoes reserved for seed on racks in a cool place protected from frost, but well ventilated. Transplant onions from seed-beds to irrigated or naturally moist lands; irrigate about once a week, but do not apply too much water. Pick over potatoes which may be lifted, and remove the bad and diseased ones. Winter cereal crops for grain can be sown towards the end of the month. Cart manure to the lands. Remember that good and deep ploughing to a depth of at least 7 to 8 inches is essential, and the basis of all successful arable farming. If the lands are not already ploughed so deep, increase the depth of ploughing about an inch a year until this depth, or even more, is reached. On lands which have been ploughed for a number of years at the same depth, use a grubber to stir up the sub-soil without lifting it to the surface. Too much attention cannot be paid to good tillage. It is usually good practice to follow the plough at once with a harrow or other suitable implement to break down the clods before they bake hard. Continue breaking up new lands; the earlier this is done the more complete is the decomposition of the vegetable matter in the soil. When making hay of coarse legumes such as velvet and dolichos beans and cowpeas, be sure that the vines are dry before stacking. Handle the hay as little as possible to avoid loss of leaf. Thought should be given to laying in supplies of thatching grass for thatching and repairing roofs. The veld may be beginning to dry off. Consideration may be given to mowing or otherwise preparing fire lines as a preventive against veld fires.

## DAIRYING.

At this season of the year the milking kraal is generally far from clean owing to the excessive amount of mud or dust which has accumulated during the latter part of the rainy season, and in consequence farmers invariably have trouble in producng first-grade cream. Every endeavour should be made to erect a small milking shed in which four or five cows or more can be milked at a time, and every effort should be made to keep the cows clean. The udders should be wiped before milking with a clean, damp cloth, and the farmer should see that the natives' hands are washed with soap and clean water before and after each milking.

If butter is made, the cream and washing water should be put out overnight, and if the cream is churned early the following morning, very little difficulty should be experienced in obtaining a good grain and a firm body in the butter.

From this time of the year onwards, cheese making operations are usually most successful. The evening's milk should not be kept in the dairy, but should be placed outside, preferably in a bath, and covered over with butter muslin, cheese cloth or mosquito gauze netting. Care should always be exercised, however, in using evening's milk. Morning's milk plus a starter usually gives the best quality, and if a starter is used, care should be taken that it shows no signs of gasiness or off flavours.

The season of abundant green pasture is over, and the natural grazing, unless supplemented by some green food or succulent roughage, is not sufficient to maintain a full flow of milk. The most economical supplement to veld grazing at this time is maize silage, and this should be fed in liberal quantities to all milking cows and growing stock. A few pounds of concentrates in addition would also be of great benefit to the milking cows, which should not be compelled to subsist entirely on veld hay and silage.

## DECIDUOUS FRUITS.

If not already done, orchards should be ploughed, harrowed and well cultivated to retain the soil moisture for spring blossoming and growth.

Varieties such as the Chinese peaches, etc., may be pruned after the leaves have dropped.

Order all trees for winter planting during June-July. August planting is unsafe for many early growing varieties of fruits.

All late apples should be harvested and stored or marketed.

## ENTOMOLOGICAL.

Maize.—Although certain pests, such as earworm and stalk borer, may be in evidence, there are practically no operations against insect pests that can be carried out economically during this month.

Tobacco.—Any remaining plants showing stem borer attack should be removed and burnt. Watch should be kept for the emergence of the adult wireworm beetles. These should be poisoned with a bait consisting of maize bran moistened with a solution of 1 lb. arsenite of soda in 20-30 gallons of water. The bait should be rolled into a small ball and scattered on the lands, one ball to each 10 square yards. The bait should be covered with a few leaves and moistened as required. Chopped green stuff such as Napier fodder may also be used as a carrier for the poison, in which case molasses should be added at the rate of 1½ gallons to 10 gallons of the arsenite solution, or cheapest sugar at the rate of 8 lbs. per 10 gallons. The bait is best laid in the evening.

Cotton.—Damage to bolls from bollworms may be noticed by the flaring of the bracts and the dropping of the bolls. All dropped bolls should be collected and destroyed. Guinea-fowl, turkeys, etc., may be encouraged to destroy stainers, etc. Stainers should be trapped in traps of cotton seed or trash and destroyed.

Citrus.—Collect and destroy infested fruit to keep down citrus codling moth. Red scale should be destroyed by fumigation with hydrocyanic acid gas or with resin wash. Soft brown scale may be controlled with resin wash. It will be controlled by fumigation with hydrocyanic acid gas where this is practised against other scale insects. Aphis may develop on young growth and may be kept down by spraying with nicotine or home-made tobacco wash.

Vegetable Garden.—Plants of the cabbage variety are liable to suffer severely from cabbage louse and Bagrada bug. The former can be kept largely suppressed by frequent washings with a strong spray of cold water or with a nicotine spray. Bagrada bug is more difficult to control. Crude carbolic emulsion, 1 part in 15 parts of water, or resin wash gives partial control. The spray must hit the insect to kill. Do not re-plant a cruciferous crop (cabbage family) on the same plot. Thoroughly clean and work the soil.

Potatoes.—Potatoes should be cultivated systematically and hilled up to keep the tuber moth from the tubers.

## FLOWER GARDEN.

The garden can generally be depended upon to make a good show in the autumn and early winter, provided that the plants have been previously kept in a healthy condition by watering, mulching and feeding. Snap dragons and other seedlings, also cuttings, may now be planted out into their permanent positions. Sowing may be made of hardy annuals, such as hollyhocks, larkspur, clarkia, pansy, petunia, sweet peas, gaillardia and candytuft. Bulbs of spring flowering plants may be taken up, divided and replanted.

## VEGETABLE GARDEN.

Sow at once all that is required to fill up the vegetable garden before the soil has parted with all moisture. Seeds sown now will germinate freely, and plants will establish themselves more quickly than during the colder weather, which can soon be expected. A start should now be made at cleaning asparagus beds. This is a most popular vegetable, and yet one rarely sees it cultivated in the ordinary Rhodesian garden.

It is supposed to be difficult to grow, but this supposition is not borne out, as, once established, a bed of asparagus is one of the most easily managed vegetables in the whole garden. Depth of good soil and plenty of manure are all that this plant requires. Rhubarb roots may be taken up, divided and replanted this month. Plant out from seed beds cabbage and onion plants into their permanent quarters. Sow a full crop of peas, broad beans, turnips, onions, lettuce and radish.

## FORESTRY.

Cultivate the soil in the young plantations either by means of machines or hand labour. The cultivation will conserve moisture. Hoed out weed growth should be applied as a mulch round the base of each young tree. Be careful not to pile earth round the stems of the young trees. Covering the stems with earth even for an inch or two interferes with sap circulation and invites attacks by termites.

Prune the young trees to single stems. Any exceptionally strong undesirable branch growth may be checked by breaking off the leading shoot, but ordinary branch growth should not be touched.

## POULTRY.

The first chicks should now be out, and these, having been hatched, must be well looked after. No food should be given for the first 36 to 48 hours. Leave them to sleep as much as possible. See that they have plenty of fresh warm air, but are not exposed to draughts. After 48 hours give some small grit and charcoal to purify the intestinal tract and aid digestion. A pamphlet dealing very fully with incubation and rearing of chickens can be obtained gratis on application to the Poultry Experts, Department of Agriculture.

One comes across many cases of wrong treatment of chickens in this country, the chief being uncleanliness, over-crowding, giving food too early and dirty drinking water. Two most important foods are animal protein, especially in the form of thick separated or whole milk and green food, especially onions or eschalots or their green tops. The loss in the rearing of chicks is very great; this should not be so if good breeding stock is used, the eggs from these are carefully handled and incubated and the chicks reared with care and common sense.

Any turkey chicks hatched at this time of the year should be well looked after. They should be kept warm, dry, free from insects, fed on dry food only, given plenty of thick separated milk, onions or onion tops, dry mash and grain. A pamphlet on turkeys and turkey rearing is obtainable gratis from the Poultry Experts.

Ducks should do well during the month, the weather being as a rule cool, moist and bracing; but the houses in which they sleep must not be damp. Duck breeders should always be on the "qui vive" for a round worm called "Trichosoma contortum," which is often fatal to ducks. It is found in the œsophagus, and causes arrest of growth, emaciation and weakness and sometimes epileptiform attacks. A swelling will be noticed at the lower part of the neck, which rapidly increases in size, and death occurs in one to three days. Onions, or preferably garlic, mixed with the food is a good preventive and cure. Another good remedy is essence of turpentine mixed with twice its quantity of olive oil and one or two tablespoonfuls given for a dose.

## STOCK.

Cattle.—Where winter conditions are good, early spring calves may be weaned now, but a common practice is to allow them to run with their dams until the early rains. Where supplementary feed is available, April to June are probably the best months of the year for cows to calve in. These months also suit the dairy farmer. Provide succulent feed for the dairy herd. Dry off cows which will not pay for a grain ration during the winter. Bullocks for winter fattening should be selected now.

Sheep.—The ewes should be kept in good shape for lambing. Put the big udder ewes on the green feed.

### TOBACCO.

The grading of the brighter grades should be proceeded with as soon as convenient. All leaf which has cured green should be bulked separately and be regularly examined to avoid serious damage through overheating. Tobacco seed heads, when mature, should be removed from the plants and stored where no damage will occur through activities by rats and mice. Care should be taken to store these seed heads with the pods uppermost, as otherwise much seed may be lost. Clear and plongh the land soon after the crop has heen harvested. Burn old stalks as a control measure against possible carry over of disease

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# May.

### BEE-KEEPING.

*Last month under normal conditions should have seen the last honey* flow of the season almost ready for robbing, for which purpose have the extractor overhauled, spare crates available, bee escape boards ready, honey jars and bottles ready for usage, and also have a few spare quilts on hand. Do not rob the bees of too much honey, remembering that sending them into winter quarters with a sufficiency of food means a strong issuing colony in the spring. Any new swarms that it may be decided to add to the apiary, feed well if necessary, to induce stimulative breeding while there is time, or if new young queens have replaced older ones also feed liberally this month in the proportion of one part of cane sugar to two of water; for the somewhat wild Rhodesian bee there is nothing like the Alexander feeder let in from the back. Keep all the spaces under hive stands clean, also inspect daily to see that white ants are not building up from the soil; if this is neglected much loss may follow. When seen, sprinkle diluted kerol from a watering can under the hive stand.

Granulation in the bottled honey can be prevented by first ripening the extracted honey in large tins covered with butter muslin for three or four days by exposure to the sun's rays. It should then be heated to a temperature of 150-160 degrees—nothing higher. As soon as this is reached withdraw the tins and bottle when cooling. The best way to obtain this heating is to place the tins in another receptacle of cold water and boil it up to the required heat, as heating it direct over a fire is very liable to burn the contents or to impair the delicate flavour of the natural honey.

### CITRUS FRUITS.

The harvesting of the early ripening fruit should be commenced about the first week in May. Exporters should cure their Washington Navels for a longer period than usual; this will enable them to detect the thick skinned fruit easily. Where necessary, irrigation should be continued up to within ten days of harvesting. All ploughing and cultivation should be completed without delay.

### CROPS.

Continue to cut and stook maize as it matures; make the stooks small to assist drying. Later in the season the stooks may be made larger. See that the stooks are secure and pick up plants lying on the ground. Continue to plough up land between stooks of maize. Give all maize harvested, whether husked or in the husk, a chance to dry out before riding to the dumps. Do not begin shelling if the ears are still damp. Do not use new

grain bags for harvesting maize. Make the dumps of unhusked ears as small as possible; the smaller the dump the quicker the grain will dry out. *Grain on the cobs dries extremely slowly, if at all, in dumps of large size.* Do not mix unhusked ears from the stooks with dryer ears harvested later from the standing crop. Keep the dryer ears in a separate dump; shell, bag and stack such maize separately. When cutting maize for stooking, insist on the stalks being cut within 2 to 4 inches of ground level. The plough, in Rhodesia, will not bury roots with stalks 8 to 12 inches high. A long stubble of stalks makes clearing of the ground for ploughing very tedious and expensive. If not already harvested, ground nuts should be lifted before the first frosts damage the hay. Finish *transplanting* onions from seed-beds. If plants are not flourishing after transplanting, give a light dressing of nitrate of soda—50 lbs. per acre. Repeat in a fortnight if needed. Sow most winter cereals on wet vleis or under irrigation early this month. Feed your sweet potato vines to stock; if frosts occur the vines will be killed. Dig and feed tubers from end of month onwards. Towards end of month harvest cattle pumpkins and melons and handle carefully; avoid bruising to prevent rotting. Place pumpkins and melons in a dry situation in the open and in a single layer. Supply plenty of roughage to cattle pens, kraals and stables to increase the manure supply. Collect and cart manure to lands for spreading. Do not attempt to plough in dry grass or quantities of maize refuse. The plough will not turn it under and it will not rot before next planting season. Burn such refuse and make a good job of the ploughing. If the weather seems set fair, commence brick-making. A small kiln of bricks always on hand is most useful. As labour permits, re-thatch buildings and outhouses in need of repair. Overhaul, grease and paint planters, drills and other implements not required again until next season, and store away under cover. Think about your fertiliser requirements for next season and place your orders. From now onwards the second ploughing of new land broken up earlier in the season should be pushed on with as opportunity offers.

## DECIDUOUS FRUITS.

The pruning of early ripening peaches should be performed this month. *All holes should be completed and* kept in readiness for June planting. Ploughing or digging and cultivation should be completed without delay.

## ENTOMOLOGICAL.

Cabbage Family.—*Plants of this family are liable to suffer greatly* from cabbage louse (aphis) and Bagrada bug during May. For the former wash the plants frequently with a strong stream of cold water from a spray pump, or spray with soap and tobacco wash. Transplants may be dipped *in the latter. Plants attacked by Bagrada bug may be sprayed with resin* wash when the young bugs are exposed in the early morning.

Citrus Trees.—Continue to collect and destroy all fruits infested with citrus codling. Fumigate or spray for scale insects if necessary.

Guava.—Fruit fly and citrus codling breed in these fruits during the autumn and winter. Collect fruit and destroy.

Tobacco.—Watch should be kept for the emergence of the adult wireworm beetles. *These should be poisoned with a bait consisting* of maize bran moistened with a solution of 1 lb. arsenite of soda in 20 to 30 gallons of water. The bait should be rolled into small balls and scattered on the lands, one ball to each ten square yards. The bait should be covered with *a few leaves and moistened as required.* Chopped green stuff such as Napier fodder may also be used as a carrier for the poison, in which case molasses should be added at the rate of 1½ gallons to 10 gallons of the arsenite solution, or cheapest sugar at the rate of 10 lbs. per 10 gallons. The bait is best laid in the evening.

Fields of tobacco found to be heavily infested with gallworm should be thoroughly ploughed and cross-ploughed and laid down to an immune crop next season.

Cotton.—Continue trapping and destroying stainers. All dropped bolls should be collected and destroyed.

Maize.—Clean up storage sites, sidings and sheds against weevil.

Potatoes.—Late potatoes should be kept earthed up to prevent tuber moth from attacking the tubers.

## FLOWER GARDEN.

The month of May is a suitable one for the preparation of new flower beds. The ground should be well trenched, and if of poor quality, a light dressing of well rotted manure will be a distinct advantage. Too heavy dressing is not advised, as too rich a soil is likely to produce an abundance of foliage and very few flowers. It is not too late to sow sweet pea seeds, but the best results come from early planting. By this time all bulbs for spring flowering will be planted. Chrysanthemums, delphiniums, dahlias and other herbaceous perennials may now be cut down, and if necessary taken up, divided and replanted

## VEGETABLE GARDEN.

It will be necessary during the early part of the month to clear off what remains of summer crops, such as haricot beans, peas, cucumbers, etc. Where winter deep rooting vegetables are to be grown, such as carrots, parsnips and beets, the soil and sub-soil should be deeply worked, so as to allow a ready root run for these vegetables. A dressing of lime will be of great value in every section of the kitchen garden. This will especially help to minimise future attacks of insects and fungus attacks. New asparagus beds may be made this month; old beds should be cut down, cleaned and kept in good order; also a light dressing of stable manure may be given to the beds. Planting may be made of all seedlings, such as cabbage, cauliflower, lettuce, onions, etc., and seeds of carrot, leek, lettuce, onions, peas, radish, turnip, parsnip, broad beans may be sown.

## FORESTRY.

Continue pricking out coniferous seedlings into tins or beds. Deciduous trees which are propagated by means of cuttings should be taken in hand. See that the fire lines are in order, and in the case of woods which have formed canopy, remove inflammable material below the edge trees.

## POULTRY.

All cockerel chickens should be separated from the pullets, and every month gone over carefully, the poorer ones eliminated and only the very best kept. Those cockerels with the deep long bodies, short legs and round heads should be kept. Those with any inclination to long legs, knock knees, long heads or thin beak, lop-over combs, narrow bodies, or those lacking length and depth should be rigorously discarded. The chickens must not be allowed to become chilled, especially at night; on the other hand, they must not sleep in a hot stuffy atmosphere. On no account must they be overcrowded; this is fatal and is one of the many rocks on which poultry keepers come to grief.

The young stock must have all they can eat; to stint them is to ruin them for good and all. A bird that has been stunted never recovers. A good quality bone meal (lime phosphate) is absolutely necessary, as is also plenty of succulent green food, and no animal protein is better than thick separated milk for the health and growth of the chickens.

Those going in for ducks should hatch according to the numbers they have to supply for eating each week. Ducks must have all the food they will eat from the time they are hatched. A quick-growing duck should put on 1 lb. per week and be ready for killing at from seven to eight weeks old. Always kill or sell for killing just before the large wing feathers commence to grow.

If the rains have stopped, turkeys can be hatched. See that the youngsters are kept warm, but also that they have plenty of fresh

air. Never feed young turkeys on wet or moist food, but give dry mash, grain, plenty of onion tops or onions chopped small, and thick separated milk. Keep them free from insect vermin; they will never thrive if they are infested with these.

Never allow the hen that has hatched the turkey eggs to run with the youngsters. Always confine her in a coop, through the slats of which the young turkeys can run in and out. The coop should be moved to fresh ground each day; nothing is worse for young turkeys than to be running on the same piece of ground for long at a time. Tainted ground is one of the chief causes of mortality among young turkeys.

## STOCK.

Cattle.—By the middle of this month dairy cattle will require more serious attention in the matter of feed. Grass should be cut for bedding, and both cows and calves should be well bedded down at night from now onwards, and cowsheds should be put in good repair. Attention should be given to the water supplies, and care taken that they are clean and sufficient.

Boggy sources of water supply are a frequent source of loss of cattle during the winter months. With adequate water supplies cattle can withstand considerable shortage of grazing. Weaners should be fed a good roughage ration—with or without a small allowance of grain, depending on circumstances—to keep them growing through the winter months.

Get in the bullocks for winter fattening.

Sheep.—The ewes should be lambing now. It is the general experience in the Colony that winter lambs are better than spring ones. Adequate feed must be provided to keep up the milk flow of the ewes. For this purpose a stand of winter oats or barley, on which the ewes can graze for an hour a day, is excellent. A little maize with a legume hay will also give very good results. Where roots do well, they will make a valuable succulent feed for sheep The sheep should have access to some shelter from the cold winds. Dock the lambs.

## TOBACCO.

Curing should be completed as early in the month as possible to prevent loss from frost. The bales of tobacco should be examined and turned weekly until they are despatched from the farm. All bulks must be inspected regularly and turned if necessary. Tobacco seed should be shelled as soon as the seed pods are dry and the seed carefully labelled and stored in a dry place. The stumping, clearing and ploughing of new land, if operations have not already been commenced, should be no longer delayed. Land which has just produced a crop should be ploughed and harrowed as soon after the harvest as possible.

## VETERINARY.

Horse-sickness will still be in evidence, and may be expected to continue until the frosts occur. Inoculation for blue tongue should be performed in the dry season only, unless the animals can be kept under cover for 21 days. Do not inoculate ewes in lamb on account of abortion. Inoculated animals spread the disease for 21 days. Scab is a poverty winter disease.

## WEATHER.

During the major portion of this month the ordinary winter conditions prevail, viz., cloudless sunny days and cold nights. Frost may be normally expected at any time during the latter half of the month. There is often, however, a recrudescence of rain conditions during the early portion of the month, resulting in overcast days and light drizzling showers, the normal rainfall at many places, particularly in the southern and eastern portions of the country, amounting to over half an inch.

# SOUTHERN RHODESIA WEATHER BUREAU.

## FEBRUARY, 1932.

*Pressure.*—Barometric pressure was consistently low towards the end of the month, and the mean pressure varied from normal to 1.5 mb. below normal.

Pressure movements were highly irregular and interesting. The equatorial low was rather to the east of its usual position on the 1st and it moved slowly eastwards crossing the coast to the south of Mossuril and lay in the Mocambique Channel on the 3rd and 4th, and then appears to have traversed Madagascar and disappeared. Cyclones were active during this period and it is believed that they "attract" the equatorial low. Lows were inactive until the 19th, when the equatorial low spread over the Union; it deepened in the east on the 20th and then withdrew to the west. On the 23rd a deep low was on the S.E. coast, which spread out on the 24th. On the 25th the equatorial low affected Southern Rhodesia; it then extended to the S.W. Cape and only weak movements occurred to the end of the month.

A high moved up the east coast on the 2nd and 3rd, and remained in the Limpopo Valley from the 4th to the 18th continuously; it then withdrew to the east and remained over Madagascar for a period. A weak high appeared in the west on the 19th and affected the S. coast for two days. The last high appeared in the west on the 24th; it showed as high pressure along the coast on the 25th, deepened in the south-east on the 26th and moved up the coast, being off Beira on the 28th and 29th.

The temperatures of the month were generally slightly above normal.

*Rainfall.*—The mean rainfall for the month amounted to 4.7 inches, approximately 1 inch less than normal, and the seasonal total to the end of February is 20.8 inches, or 2.2 inches below normal.

The distribution in February was as follows:—

| | February, 1932. | Normal, February. |
|---|---|---|
| Zone A ... ... ... ... ... ... ... ... ... | 3.6 | 4.8 |
| Zone B ... ... ... ... ... ... ... ... ... | 3.2 | 3.7 |
| Zone C ... ... ... ... ... ... ... ... ... | 5.3 | 6.9 |
| Zone D ... ... ... ... ... ... ... ... ... | 6.8 | 7.1 |
| Zone E ... ... ... ... ... ... ... ... ... | 3.6 | 6.4 |
| Zone F ... ... ... ... ... ... ... ... ... | 5.4 | 10.2 |

*Rain Periods.*—Showers were numerous in the north-east on the 1st and 2nd, with scattered showers from the 3rd to 5th. Rain increased in Mashonaland from the 6th to the 12th, and it was generally fine from the 13th to the 15th. Showers were numerous on the 16th and continued numerous to fairly general to the end of the month.

## FEBRUARY, 1932.

| Station. | Pressure Millibars, 8.30 a.m. Mean. | Pressure Normal. | Temperature in Stevenson Screen °F. Absolute. Max. | Absolute. Min. | Mean. Max. | Mean. Min. | Mean. ½ Max Min. | Mean. Normal. | Mean. Dry Bulb. | Mean. Wet Bulb. | Rel. Hum. % | Dew Point F. | Cloud Amt. 0-10 | Precipitation. Ins. | Precipitation. Normal. | Precipitation. No. of Days. | Altitude (Feet). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bulawayo ... | 867.0 | 867.0 | 90 | 56 | 82.7 | 61.5 | 72.1 | 70.3 | 69.9 | 63.3 | 69 | 59 | 6.5 | 2.96 | 4.1 | 11 | 4,436 |
| Gwelo ... ... | 860.7 | ... | 88 | 54 | 81.2 | 60.3 | 70.8 | 70.9 | 69.0 | 63.7 | 75 | 61 | 4.7 | 2.39 | 5.3 | 9 | 4,632 |
| Riverbank ... | ... | ... | 95 | 58 | 85.9 | 62.7 | 74.3 | 73.5 | 72.0 | 65.3 | 70 | 62 | ... | 3.87 | 4.5 | 10 | 4,100 |
| Essexvale ... | ... | ... | 100 | 59 | 88.8 | 64.6 | 76.7 | 72.9 | 71.5 | 65.4 | 72 | 62 | .. | 2.07 | 5.2 | 6 | 3,828 |
| Gwanda ... | 904.1 | ... | 94 | 61 | 86.5 | 64.7 | 75.6 | ... | 73.8 | 66.1 | 67 | 62 | 3.6 | 2.70 | 3.7 | 8 | 3,235 |
| Mazunga ... | 945.7 | 947.2 | 98 | 59 | 89.3 | 66.1 | 77.7 | 78.3 | 76.3 | 69.4 | 71 | 67 | 6.0 | 4.54 | 3.2 | 7 | 1,970 |
| Nuanetsi ... | ... | ... | 99 | 58 | 90.4 | 66.8 | 78.6 | .. | 76.1 | 70.1 | 74 | 68 | 6.9 | 1.07 | 2.2 | 4 | 1,630 |
| Between Rivers | ... | ... | 89 | 57 | 82.4 | 61.5 | 72.0 | ... | 69.4 | 65.8 | 83 | 64 | 5.9 | 3.38 | 4.8 | 13 | 3,970 |
| Enkeldoorn ... | ... | ... | 86 | 54 | 79.6 | 59.3 | 69.5 | 69.7 | 68.5 | 63.3 | 75 | 61 | 6.3 | 2.55 | 6.2 | 10 | 4,720 |
| Gatooma ... | ... | ... | 91 | 56 | 85.0 | 61.1 | 73.1 | 73.8 | 72.3 | 66.8 | 75 | 64 | 4.8 | 3.85 | 7.7 | 13 | 3,850 |
| Miami ... ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4,090 |
| Salisbury ... | 853.2 | 854.2 | 86 | 54 | 78.9 | 59.9 | 69.4 | 69.4 | 68.0 | 63.2 | 76 | 60 | 7.5 | 3.85 | 5.2 | 15 | 4,865 |
| Sinoia, Citrus ... | ... | ... | 87 | 59 | 81.4 | 62.5 | 72 0 | ... | 71.1 | 66.5 | 79 | 65 | ... | 4.75 | 7.3 | 12 | 3,830 |
| Sipolilo... ... | ... | ... | 87 | 60 | 79 6 | 63.6 | 71.6 | ... | 70.9 | 65.9 | 77 | 63 | 5.8 | 6.04 | 8.2 | 16 | 3,900 |
| Juliasdale ... | ... | ... | 79 | 50 | 72.2 | 55.7 | 63.9 | 63.1 | 66.0 | 62.0 | 80 | 60 | ... | 7.10 | 7.9 | 13 | 6,070 |
| Mtoko ... ... | ... | ... | 82 | 59 | 79.3 | 62.9 | 71.1 | ... | 69.5 | 65.0 | 78 | 63 | 6.7 | 5.87 | 5.6 | 9 | 4,210 |
| Shamva ... | ... | ... | 91 | 61 | 80 5 | 65.3 | 72.9 | ... | 72.8 | 68.7 | 81 | 67 | 6.4 | 7.33 | 7.5 | 15 | 3,170 |
| Angus Ranch ... | ... | ... | 96 | 63 | 88.2 | 68.8 | 78.5 | 76.4 | 76.9 | 70.0 | 71 | 67 | ... | 4.63 | 4.1 | 9 | 2,300 |
| Craigendoran ... | ... | ... | 97 | 56 | 88.6 | 64.7 | 76.7 | ... | 76.8 | 69.4 | 69 | 66 | ... | 2.43 | 5.6 | 11 | 3,430 |
| New Year's Gift | ... | ... | 91 | 59 | 84.3 | 64.3 | 74.3 | ... | 73.2 | 67.5 | 75 | 65 | ... | 2.88 | 5.0 | 7 | 2,700 |
| Nyamasanga ... | ... | ... | 82 | 50 | 79.0 | 58.0 | 68.5 | ... | 69.2 | 62.7 | 69 | 59 | ... | 6.03 | ... | 13 | 5,080 |
| Riverdene North | ... | ... | 93 | 50 | 86.0 | 60.8 | 73.4 | ... | 72.8 | 66.1 | 70 | 63 | ... | 2.06 | 4.3 | 10 | 3,700 |
| Stapleford ... | ... | ... | 78 | 47 | 72.2 | 55.3 | 63.8 | ... | 64.3 | 61.2 | 84 | 59 | 6 8 | 13.49 | 16 9 | 19 | 5,450 |
| Umtali ... ... | 890.7 | 891.1 | 88 | 57 | 81.2 | 62 3 | 71.8 | 71.5 | 71.4 | 66 0 | 75 | 63 | 5.4 | 4.99 | 6.3 | 14 | 3,677 |
| Victoria ... | 893.6 | 894.2 | 90 | 53 | 83.1 | 61.8 | 72.5 | 71.5 | 72.7 | 65.3 | 67 | 61 | 5.5 | 1.54 | 5.0 | 8 | 3,570 |
| Melsetter ... | 848.8 | ... | 80 | 51 | 75.4 | 58.0 | 66.7 | ... | 66.7 | 62.3 | 78 | 60 | 5.1 | 4.43 | 9.0 | 14 | 5,060 |
| Mount Selinda | ... | ... | 85 | 58 | 77.7 | 62.7 | 70.2 | ... | 67.8 | 65.0 | 86 | 62 | 6.4 | 7.94 | 11.7 | 15 | 3,520 |

# NOTES FROM THE "GAZETTE."

| *"Gazette" Date.* | *Items.* |
|---|---|
| | DEPARTMENT OF AGRICULTURE. |
| 11.3.32. | It is hereby notified for public information that the following scale of charges will apply for analysis by the Chemical Laboratory:— |

| Item | £ s. d. |
|---|---|
| Partial analyses of soil samples from bona fide farmers to determine suitability for crops, and/or to make manurial recommendations ... ... ... ... ... ... ... | Free |
| Complete analysis of a soil sample, including report and recommendations ... ... ... ... ... ... ... ... ... | 4 4 0 |
| Partial analysis of any unregistered fertiliser or feeding-stuff, for each constituent ... ... ... ... ... ... ... | 0 15 0 |
| Partial analysis of a registered fertiliser or feeding-stuff, taken according to provisions of Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance ... ... | 1 1 0 |
| Complete analysis of any unregistered fertiliser or feeding-stuff ... ... ... ... ... ... ... ... ... ... ... ... | 3 3 0 |
| Complete analysis of a registered fertiliser or feeding-stuff, taken according to provisions of Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance | 4 4 0 |
| Analysis of water for agricultural purposes ... ... ... | 0 10 6 |
| Limestone, estimation of lime content ... ... ... ... ... ... | 0 10 6 |
| Limestone, complete analysis ... ... ... ... ... ... ... ... | 1 1 0 |
| Milk, cream or butter, for each constituent ... ... ... | 0 10 6 |
| Milk, cream or butter, complete analysis ... ... ... ... | 1 1 0 |
| Cattle dips ... ... ... ... ... ... ... ... ... ... ... ... ... ... | 0 10 6 |
| Viscera of animals—arsenic ... ... ... ... ... ... ... ... | 0 10 6 |
| Viscera of animals—strychnine, cyanide, nitrates or copper ... ... ... ... ... ... ... ... ... ... ... ... ... ... | 1 1 0 |
| Viscera of animals—general examination for poisons, from ... ... ... ... ... ... ... ... ... ... ... ... ... ... | 3 3 0 (depending on time involved.) |

Samples to be delivered free of cost to the Department and to be accompanied by remittances for analysis required. No modification or remission will be made in any of these fees, except with the authority of the Minister of Agriculture.

# GWEBI PRODUCE PRICES.

| | |
|---|---|
| Hull-less oats ... ... ... ... ... ... | 40/- per bag of 150 lbs. |
| Large Black sunflower seed ... | 14/- per bag of 100 lbs. |
| Dolichos beans ... ... ... ... ... | 35/- per bag of 200 lbs. |
| Linseed ... ... ... ... ... ... ... ... ... | 60/- per bag of 200 lbs. |
| Linseed (quantities under 100 lbs.) ... ... ... ... ... ... ... | 4½d. per lb. |
| Sweet potato tubers (Calabash Leaf) ... ... ... ... ... ... ... | 6/- per bag of 150 lbs. |
| Napier fodder roots ... ... ... ... | 6/- per bag of 40 lbs. |
| Sweet potato cuttings (Calabash Leaf) ... ... ... ... ... ... ... | 6/- per bag of 40 lbs. |
| Edible canna corms ... ... ... ... | 10/- per bag of 150 lbs. |
| Pumpkin seed ... ... ... ... ... ... | 1/1 per lb. |

All prices quoted are for *delivery free at any station or siding* in Southern Rhodesia. Before sending cheques, intending purchasers are advised to ascertain that the seeds, etc., required are still available. Cheques should be made payable to "Gwebi Farm." All orders and enquiries should be addressed to the Chief Agriculturist, Department of Agriculture, Salisbury, *not direct to the Gwebi Farm.*

# DEPARTMENTAL BULLETINS.

**The following Bulletins, consisting of reprints of articles which have appeared in this Journal, are available for distribution at 3d. per copy. Application should be made to the Editor, Department of Agriculture, Salisbury, and remittances must accompany orders.**

## AGRICULTURE AND CROPS.

No. 225. Napier Fodder or Elephant Grass, by J. A. T. Walters, B.A.

No. 374. Fibre Crops—Deccan Hemp (Hibiscus Cannabinus) and Sunn Hemp (Crotolaria Juncea), by J. A. T. Walters, B.A.

No. 429. Propagation of Kudzu Vine, by H. C. Arnold.

No. 442. Swamp or Irrigation Rice, by K. V. Yoshi, Bombay.

No. 510. Check-row Planting of Maize, by H. G. Mundy, F.L.S.

No. 545. Artificial or Synthetic Farmyard Manure, by H. G. Mundy, Dip.Agric., F.L.S.

No. 550. Onion Growing under Irrigation, by C. Mainwaring.

No. 561. Wheat Growing in Rhodesia, by C. Mainwaring.

No. 568. The Treatment of Arable Land, by G. N. Blackshaw, O.B.E, B.Sc., F.I.C.

No. 598. Drought-resistant and Early-maturing Crops for Areas of Late Rainfall, by C. Mainwaring.

No. 599. Rhodesian Soils and their Treatment, by E. V. Flack.

No. 630. The Storage of Seed Potatoes, by H. C. Arnold.

No. 634. Barley, by P. V. Samuels.

No. 643. Noxious Weeds in Southern Rhodesia, by F. Eyles, Botanist.

No. 650. Coffee Culture in Southern Rhodesia, by G. W. Marshall, Horticulturist.

No. 651. Two Important Leguminous Crops: The Velvet Bean and Dolichos Bean, by C. Mainwaring, Agriculturist.

No. 657. Hay-making in Southern Rhodesia, by C. Mainwaring, Agriculturist.

No. 663. The Use of Fertilisers and Manures in Southern Rhodesia, by A. D. Husband, A.I.C., Chief Chemist.

No. 672. Hay-making in Rhodesia, by H. G. Mundy, Dip.Agric., F.L.S.

No. 674. Top Dressing of Maize against Stalk Borer, by H. C. Arnold.

No. 681. The Sunflower (Helianthus Annuus) (Revised), by S. D. Timson, M.C., Dip.Agric.

No. 694. The Edible Canna (Canna Ednlis), by D. E. McLoughlin.

No. 695. The Castor Oil Plant (Ricinus spp.), by S. D. Timson, M.C., Dip.Agric.

No. 697. Results of Analysis of Samples taken under the "Fertilisers, Farm Foods, Seeds and Pest Remedies Ordinance" during the year 1927-28.

No. 704. The Importance of Research on Pasture Improvement in Southern Rhodesia, by A. D. Hnshand, A.I.C., Chief Chemist.

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